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SYNTACTIC AND PHONOLOGICAL EFFECTS ON THE ROLE OF DURATION AS A CUE TO VOWEL QUALITY

BY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Syntactic and Phonological Effects on the Role of Duration as a Cue to Vowel and Voicing Categorization. submitted by Brian FitzJohn Doherty in partial fulfilment of the requirements for the degree of Master of Science in Speech Production and Perception.

ABSTRACT

Vowel length was found to be a sufficient cue for both the phonemic categorization of certain vowels and the phonemic categorization of voicing in perceptual experiments. An amplified voicebar was found to suppress the influence of vowel duration on the voicing categorization. The duration of the pause following the CVC in the phrases "The big CVC could be here" and "The CVC could be here" was found to shift the vowel categorization and voicing boundaries. There were also small differences between the results for the frame "The CVC could be here" and "The big CVC could be here". The intonation contour on "could be here" did not affect the categorization of the vowel or voicing. The effect of these three more global factors was found to be slight and easily separated from the strong effect of the local factors; vowel duration and voice bar amplitude.

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I. Introduction

In the study of communication equal emphasis must be given to research on the production of signals and research on the perception of signals. The synthesis of results in these two general areas of research can then produce a unified theory of the communication system as a whole.

Recent work on the timing of segments in natural speech has concentrated on production. Three main results of this work form the basis of this study. First, there is the concept of the intrinsic duration of a vowel. In English the categorization of a specific phone as a particular vowel phoneme is due to a combination of its phonetic quality, ie., its position in the vowel formant space, and its duration. The vowels /I,ɛ,ʊ,ʌ,ɔ/ are "short" vowels while /i,e,u,æ o,a/ are "long" vowels. Under most conditions the duration of a vowel is one cue to its identity (Ainsworth, 1972 and Peterson and Lehiste, 1960). Second, there is the dependence of both vowel quality perception and the perception of voicing in the following consonant on the duration of the vowel (Hogan and Rozsypal, to appear and Mermelstein, unpublished). Third, there is the concept of syntactic effects on timing. Thus syllables at the end of surface structure phrases are longer than syllables in other locations (Huggins, 1975 and Klatt, 1975).

In preparation for this study a list of all monosyllabic English words of the form CVC where C = {p,t,k,f,ð,s,š,b,d,g,v,θ,z,ž} and V = {i, I,æ,ʌ,u,ʊ,e,ɛ,o,ɔ} was prepared (see Appendix 1).

A quadruple of words, C+V1+C1, C+V1+C2, C+V2+C1, C+V2+C2, was sought such that;

a. C1 and C2 differed only in voicing,

b. the regions in formant space categorized as V1 and V2 overlapped or bordered one another,

c. V1 and V2 were intrinsically long and short, respectively,

d. the four words were commonly used,

e. the four words were always used as the same part of speech, and

f. the four words shared enough semantic features that they could be used in the same syntactic frame without semantic anomaly.

Of the possible quadruples listed in Appendix 1 only "cub, cup, cob, cop" - phonemically, /kʌb, kʌp, kɔb, kɔp/ - satisfied all of these requirements. The formant space in the region of the /ɔ,ʌ/ categorization is less crowded in the Canadian dialect studied than in some American dialects.

The present study addresses several related questions. First, the most basic question, is vowel length a sufficient cue for the phonemic categorization of certain vowels in perceptual experiments? If not, then a straight formant theory of the perception of English vowel phonemes might be sufficient. Otherwise a theory of the perception of vowel phonemes must incorporate duration as an important cue. This study demonstrated clear perceptual boundaries between /ɔ/ and /ʌ/ categorizations on the continuum of vowel duration.

Second, can the interaction of vowel phoneme perception and the perception of voicing in the following consonant be eliminated by a second, sufficient cue to voicing? Voice bar was used as the second cue. A voicebar is produced by periodic vibration of the glottis after oral closure. Acoustically the voicebar is a single band of energy at the fundamental frequency. This cue eliminated the effect of duration on the perception of voicing. Production measurements had not suggested that such an extreme effect would be found.

Third, and most interesting, is the perceptual boundary affected by the position of the vowel in a phrase? If not, then the domain of a theory of English vowel perception could be restricted to the syllable. Otherwise, position in a phrase must be incorporated into any theory of vowel quality perception, even in the speech of a familiar speaker at a constant speaking rate. Within the limits of this study, phrase context did slightly shift the position of the perceptual boundaries.

In summary, both local and global features of the speech signal may affect the phonemic categorization of a vowel sound as a function of the vowel's duration. The vowel's duration or its position in formant space would be strictly local features. Slightly more distant features would be the presence, amplitude and duration of a voicebar on a following consonant. Yet more global features would include; the number of unstressed syllables in the same phrase, the position of the vowel in the phrase, and the position of the major stress in the phrase. The most global features include the position of the major sentence stress, the

overall rate of speech, and even semantic associations. The general conclusion of this study is that both local and global variables have significant effects on vowel phoneme and consonantal voicing categorization. But the local variables play the major roles and a general description of their effect can be made independent of the global variables.

II. Literature Review

A. Phonemic Categorization of Vowels

Production

House (1961) distinguished two types of vowel lengthening. Primary lengthening is claimed to be a learned part of English phonology. It occurs in tense vowels /i,e,æ,ɝ,a,ɔ,o,u/ (vs./I,ɛ,ʌ,ʊ/) and before voiced consonants. Secondary lengthening is said to be a function of the articulatory process. This includes lengthening of open vowels /ɛ,ʌ/ (vs. close vowels /I,ʊ/) and vowels before fricative consonants. Vowel openess corresponds to tongue height. The tongue is higher for a tense vowel than a lax one and it is higher for an open vowel than a close vowel. The present study is concerned mainly with duration as a cue to /ɔ/ vs /ʌ/ and voiced vs. voiceless consonants. Thus it deals with what House termed primary lengthening.

Klatt (1975) measured the durations of stressed and unstressed vowels in connected discourse. The average length of stressed /ɔ/ was 150 msec. The average length of stressed /ʌ/ was 90 msec. Klatt (1976) provided a rather thorough review of recent literature on variation in vowel length. Differences in duration due to the intrinsic nature of the segment type such as /ɔ/ vs. /ʌ/ accounted for about half the variance in stressed vowel durations in a connected discourse. This leaves a great deal of variation to be explained by other factors such as the rate of

speech, the vowel's immediate phonetic environment, pauses, and even prosodic features.

Perception

Mermelstein (MS, unpublished) synthesized "bat, bet, bad, bed" with:

a. the first formant varying from 625 to 650 to 675 Hz, and

b. the vowel's duration varying from 48 to 240 msec in 8 msec steps.

He refuted Lindblom's claims (Lindblom and Studdert-Kennedy, 1964) that a listener corrects for coarticulation affects when a rapid speaker undershoots a vowel. Lindblom assumed that the basic cue to the perception of the openess of a vowel was the position of its first formant. Lindblom claimed that when a speaker talks rapidly he is unable to produce as high a first formant as in slow speech. He predicted that when a listener is processing a short vowel, allowance is made for the speaker's difficulty in producing a high first formant. Thus a short vowel will be accepted to be as open as a longer vowel with a higher first formant. Mermelstein found that this was not true. He found that both a long duration and a high first formant were cues to openess. He found that a short vowel was as open as a longer vowel only if the longer vowel had a lower first formant. This contradicts the assumption that the position of the first formant is the basic cue. The formant position and duration cues have more nearly equal weights and are traded off against each other.

This is an example of how two local features interact in the perception of vowel phonemes. In the present study it will be shown that a more global feature and a local feature can interact in a similar manner. Generally, the affect of the more global feature is small compared to the affect of the local features. Three weaknessess in Mermelstein's results are;

a. the small number of subjects,

b. the significant differences among the subjects, and

c. lack of control of the subject's perception of speaking rate.

The present study used a larger number of subjects but the differences among the subjects have not been analyzed. The subjects' perception of speaking rate was controlled by the use of entire sentences in the present study.

Ainsworth (1972) used synthetic vowels that;

a. spanned the F1-F2 space,

b. had lengths from 120 msec to 600 msec, and

c. were embedded in a hVd context.

Speakers of British English labelled the stimuli as one of the following; "who'd, hood, hod, hoard, hard, hud, heard, head, had, hid, heed, non-vowel, non-English". His results suggest that duration may be a more important perceptual cue for vowel recognition in the hVd context than with isolated vowels. The immediate phonetic context hVd is a slightly more global factor than vowel duration. The more global factor appears to affect the salience of the more local factor. The purpose of the present

study is to examine the interactions of such global and local features. Ainsworth identified /u,ɔ,ɑ,ɝ,i/ as long vowels and /ʊ,o,ʌ,ɛ,I/ as short vowels. Ainsworth did not present an objective analysis of the data to support the conclusion that, "nearest neighbours in the F1-F2 space are more strongly dependent on duration than the others." But this conclusion is easily accounted for with a functional analysis of phonetic cues.

B. Interaction with Voicing Cues

Production

Peterson and Lehiste (1960) found that a given vowel was longer before a voiced consonant than before the corresponding voiceless consonant by a ratio of 3:2. They also found that the duration of a long vowel nucleus before a voiceless consonant overlapped the duration of a short nucleus before a voiced consonant.

House (1961) found that the duration of tense vowels before voiceless consonants overlapped the duration of lax vowels before voiced consonants. This would suggest that if duration is used as a cue to both vowel phoneme categorization and voicing categorization then there will be an interaction of the two categorizations as the single cue, vowel duration, is varied.

Physiology

Malécot (1970) found a correspondence between the intrabuccal pressure and reported "force of articulation". The fortis or voiceless consonants require more effort and coincide with a higher intrabuccal pressure. The lenis or voiced consonants require less effort and coincide with a lower intrabuccal pressure. The role of force of articulation appears to be most important for final consonants. The duration of vowels before a final consonant varies inversely with the reported force of articulation. Malécot suggests that there are several cues for the fortis/lenis distinction;

a. presence/absence of voice bar,

b. contrastive vowel duration,

c. contrastive closure duration,

d. contrastive transition rates,

e. contrastive transition saturation, and

f. contrastive noise intensities.

The present study deals with the first two of these possible cues.

Perception

Hogan and Rozsypal (to appear) used five levels of gating of the vowel nucleus. They found that the perceptual cues to the voicing of the following consonant that could override the cue of duration included;

a. voice bar duration,

b. duration of the silent interval between the vowel and final release of the transient, and

c. consonant duration.

It appears that the listener weights the cues that are available. They found that before stops vowel duration could cause a cross-over in the voicing categorization only if the voicebar was short. A similar effect was found in the present study. Cross-over occured only in the absence of the voicebar.

Mermelstein (MS, unpublished) found no interaction between the vowel categorization and the consonant categorization when they were both cued by duration. "Two separate phonetic decisions based on overlapping range of the signal are adequate models and feedback from the output of the phonetic decisions need not be explicitly introduced." The present study supported this conclusion in that the transition from /kʌp/ to /kɔp/ in the absence of a voicebar appears the same as the transition from /kʌb/ to /kɔb/ in the prescence of a voicebar.

C. Broad Contextual Effects

Production

Lindblom (1963) studied vowel reduction in Swedish. He developed a theory of vowel formant 'targets'. He attempted to put neural events in a one-to-one correspondence with linguistic categories. The same neural events are supposed to occur for each instance of a given vowel. These events specify the target. Since the articulators move with finite speed

the target will not be reached in short vowels. The listener must correct for this. Lindblom says that a given vowel length will produce set values of F1 and F2 for a given target regardless of whether stress or rate produced that vowel length. Mermelstein's (MS, unpublished) criticism of such an analysis is weakened by the fact that he did not control the subject's perception of stress or rate. The present study made an effort to control such global factors but did not manipulate the formant values. Language differences cannot be overlooked either. The present study deals only with English and can make no claims concerning other languages.

Huggins (1975) measured the duration of stressed syllables in the sentences, "Cheese(s) (a)bound(ed) (ab)out." He claimed that the unstressed syllables affect the duration of a preceding stressed syllable except where blocked by an intervening syntactic boundary. Normally the extra unstressed vowels shorten the stressed one. So syntactic boundaries and the number of syllables in a phrase are global features that may affect the perception of vowel duration and thus phonemic categorization. Huggins suggested that it would be possible to synthesize the effects of metric feet and syntactic variables. There are two main objections to this work;

a. The syntactic boundaries perceived by the linguist do not neccessarily have any psychological reality.

b. It is assumed that the different semantic content of "Cheese bound out." and "Cheeses abounded about." plays no role in determining stress and subsequently duration.

The present study did not directly address Huggin's hypothesis because the perception of stress on the CVC was not manipulated. Future work could use semantic preconditioning to control the perception of stress on the CVC or on "big". Huggins data might be reanalyzed in terms of phrase final vowel lengthening. Then the extra unstressed syllables would not directly shorten the stressed syllable. They would indirectly shorten it by moving it out of the phrase-final position. The present study did find evidence that the more global features of phrase context did affect the perception of vowel duration in a small but significant manner.

Klatt (1975) measured the durations of stressed and unstressed vowels in connected discourse. He found that syllable length doubled at the end of a sentence. Vowel lengthening before a voiced consonant occurred only at the end of a phrase. Constituent boundaries were usually marked by changes in vowel duration. The vowel's position in the phrase, the phrase's position in the sentence, and the location of constituent boundaries are global features that may affect the perception of vowel duration. Klatt stated that the fundamental frequency contour was not distinctive at the subject-verb boundary but lengthening was. He claimed that a model based only on semantic importance and stress levels would not account for the data. In the present study the differences between the frame "The CVC ..." and the frame "The big CVC..." could be interpreted in line with Klatt's remarks on lengthening at the subject-verb boundary. The affect is small and might also be accounted for with a semantic interpretation. Further investigation would be necessary to settle the point.

Cooper (1976b) found that,

> "speakers lengthened the last two syllables of the verb 'expected' when it was followed by a complement clause in the surface structure of the sentence, as compared with when it was followed by a simple phrase in surface structure, which, according to one linguistic analysis, was derived from a full complement in underlying structure. This finding suggested that a speaker's surface structure representation of an utterance is the primary level of syntactic representation that exercises control over syllable timing. Further, the differences in the sentences was two words after the verb. Thus the speakers in this study were computing the durations of syllables in part as a function of the hierarchical structure of the sentences rather than on a linear word-by-word basis."

This production study demonstrates the influence of quite global factors on vowel duration. The present study does not use the same sentences but similar global factors were found to have only a minor effect on the role of vowel duration in perception.

Klatt (1976) claims that utterance final lengthening over several syllables is probably related to a general deceleration of motor activity at the end of the speech act. However, lengthening of the phrase final syllable at sentence internal phrase boundaries can be interpreted as a planning unit marker. Combining duration with intensity, pitch, and vowel quality may leave no ambiguity about phrase structure. Duration of the phrase final syllable can serve as a primary cue for the decoding of surface structure in spoken sentences. A future study could use the same approach as the present one to pursue this matter. It would be necessary to compose a pair of sentences with the same sequence of words but

different surface syntactic structures. A CVC such as used in the present study could be placed at one of these boundaries. Then the affects of the duration of the vowel in the CVC and semantic preconditioning on the perception of the sentence could be investigated.

Goldhor (1976) found that a single noun as subject is shorter than when it is subject while modified by an adjective. Klatt (1976) suggested on the basis of this work that a single noun as subject may be grouped with the verb in a single phonological phrase.

Cooper, Sorensen, and Paccia (1977) claim that nonadjacent segment correlations provide a rich testing ground for assessing the influence of a speaker's grammatical code on speech timing. They draw many conclusions from the fact that 21 out of 24 possible correlations were positive. But all of them are without a strong statistical foundation since only 2 of the 21 were statistically significant.

Cooper, Lapointe, and Paccia (1977) assume that they know where the syntactic boundaries within sentences are and assume that they know what the phonological rules are. Then they seek experimental evidence of how syntactic boundaries block phonological rules. They are looking for evidence of the interaction of two hypothetical constructs without checking the psychological validity of the constructs.

Perception

Huggins (1972a) attempted to measure the just noticeable differences of segment duration in naturally spoken sentences. Unfortunately the phonetically trained subjects were asked to use an internal standard of "normal" length to judge differences. Thus the standard psychophysical paradigm for the measurement of just noticeable differences was not used. Rather, the subjects were to decide whether the duration of a single segment in an utterance was "normal" or "long". In a second set of tests the decision was "normal" or "short".

The shifts in boundaries observed in the present study ranged from 2 to 63 milliseconds. Huggin's results suggest that any systematic duration difference less than 20 msec is unlikely to be perceptually significant. In the present study statistically significant boundary shifts amounted to about 20 msec or more. Huggins showed that differences in duration of this size could be perceived. The present study shows that such differences are used by the listener in speech processing.

Ainsworth (1972) examined the effect of rhythm on vowel identification. Two different sequences of three neutral vowels were used as introductions to the test vowels. One contained 160 msec sounds, the other 640 msec ones. The change in introductory sequences "had the same perceptual effect as changing the duration of a 240 msec vowel by approximately 120 msec."

To test speaking rate as a truly global feature entire passages of text should be used as stimuli. Ainsworth looked at the effect of the duration of three preceding vowels, a more local feature. In the present study an attempt was made to manipulate natural speech in a more sophisticated manner. The affect of different natural sounding stress patterns and syntactic frames was investigated.

Fujisaki, Nakamura, and Imoto (1975) examined the perception of phonemic length in Japanese. All the vowels and some consonants have 'longer' phonemic counterparts that can be discriminated largely by their duration. The perception of synthesized speech and nonspeech sounds was investigated with a two alternative forced-choice task. A change in the talking rate from 160 msec per mora to 250 msec per mora changed the phoneme boundary (using real-word minimal pairs) from 140 msec to 200 msec. The results also suggested that duration cues for vowels, nasals, and voiceless plosives were processed by the same mechanism.

The 60 millisecond shift is the same as the largest shift observed in the present study. Real-word minimal pairs are also used in the present study since the affect of the syntactic frame was investigated. In Japanese, vowel duration is a phonemic feature independent of vowel quality. In English phonetic vowel quality and duration combine to determine phonemic categorization. The magnitude of the shifts in the phoneme boundary are comparable in the two studies. But the major differences between the two languages limits the range of possible comparisons and conclusions.

Lehiste (1976) found that "at least in some positions, listeners may perceive units with changing fundamental frequency as longer than their measured length would indicate." For this reason the fundamental may be an important variable controlling the role of vowel duration in phonemic categorization. The present study used a constant 100 Hz fundamental in the CVC being studied. So Lehiste's conclusion was not directly tested. The two different stress patterns on the end of the sentences, "The (big) CVC could be here.", were realized with two different fundamental frequency contours. But these differences had no significant affect on phoneme categorization in the CVC.

Klatt (1976) concludes that systematic duration changes of less than 25 msec, ie. of 20% (Weber's law) are perceptually of much less importance than longer ones. The major statistically significant boundary shifts in the the present study were 20 msec or more.

Klatt also reports that the speaking rate for the preceding seven syllables changes the voice-onset-time (VOT) boundary in synthetic syllables. This is another example of the affect of a global feature on the perception of speech sounds.

III. The Experiment

A. Preparation of Stimuli

Prof. John Hogan, a Canadian, was recorded pronouncing the sentences "The (big) $\{$cop, cob, cup, cub$\}$ could be here" with level tone, falling tone, and with stress on "here". The four words "cub, cup, cob, cop" were also recorded pronounced in isolation. The eight sentences pronounced with a level tone were used as distractor stimuli. They were digitally sampled at 16 kHz and stored in computer memory. The phrase "the big" was copied from the sentence "The big cob could be here" and stored separately as THEBIG. The words "the" and "could" were stored as THE and COULD. The same sentence pronounced both with stress intonation on "here" and with falling intonation on "here" was sampled and stored. The phrase "be here" was copied off of both sentences and stored as BEHEREUP and BEHEREDN.

The word "cob" pronounced in isolation was sampled and stored. The particular pronunciation was chosen for its steady formants as seen on the spectrogram in Fig. 1. The waveform was divided into three segments. The first consisted of the initial noise burst and the first four pulses of the vowel. The third consisted of the last four pulses of the vowel and the final voicebar. The second segment consisted of the remaining vowel pulses. The last pulse of the first segment and the first two pulses of the last segment were trimmed away so that very short vowels could be produced. The voicebar on the third segment was amplified by a factor of two so that two extremes on the scale of voicebar strength could be

produced. The resulting segments were stored under the names C and B respectively. The second segment was pruned down to six vowel pulses and named OPRUNE. Four copies of it were repeated to produce a segment named OPRUNEX4. The additional pruning was necessary to avoid any small discontinuous jumps in formant values when the segment was repeated. The fundamental frequency was 100 Hz. Five subsegments were defined on this segment. They were named O1, O6, O11, O16 and O21 and consisted of 1, 6, 11, 16 and 21 vowel pulses, respectively. Segment B was copied and the voicebar was silenced on the copy. The copy was named segment P. Fig. 2 contains oscillograms of C, B, P, and OPRUNE.

Finally, two segments of silence, 64 and 128 msec in duration, were stored under the names SHORTSIL and LONGSIL.

Thus all the segments were stored that were necessary to produce;

1. eight original pronunciations used as distractor stimuli, and
2. all eighty combinations of the factors;
    a. Voicebar present and amplified or absent on the final consonant of the CVC,
    b. five different durations of V in the CVC,
    c. the frames:
        1) "The CVC could be here".
        2) "The big CVC could be here".
    d. stress or falling intonation on "here", and
    e. a 64 or 128 msec pause after the CVC.

In summary, the experimental stimuli consisted of all sequences generated by the following minigrammar; $\{$THE, THEBIG$\}$ + C + $\{$01, 06, 011, 016, 021$\}$ + $\{$B, P$\}$ + COULD + $\{$BEHEREUP, BEHEREDN$\}$.

All of the above work was done using the ALLIGATOR programming system for psychoacoustic experimentation. Programs were written to play back sentences and words according to the entries in random lists. The programs and the lists are in the appendix.

B. Lists of Stimuli

Two random sentence lists were prepared. They are listed in the appendix. The first eight entries of both lists were the same eight original pronunciations of "The (big) $\{$cub, cup, cob, cop$\}$ could be here" with a level tone. This was followed by eight introductory experimental sentence stimuli. The eighty experimental stimuli required by a fully crossed design followed in random order and in blocks of five. Each block was preceded by one of the original pronunciations in a level tone. The two sentence lists differed in the order of the 80 experimental stimuli. These lists will be referred to as sentence lists one and two. The first 61 CVC's in sentence list one were used to construct a word list containing 40 different experimental CVC stimuli. Unfortunately the CVC's were not in equal numbers in this word list although all were present at least twice.

C. Subjects

All the subjects were native speakers of English with no known hearing problems.

Twenty male subjects were recruited from the student residence at the University of Alberta. None had a background in linguistics or phonetics. Ten of these were presented the lists in the order: sentence list one, sentence list two, word list. Seven of these subjects did the test on Nov. 22 and three on Nov. 23. All of these first 10 subjects lived in Alberta before coming to the University of Alberta. The remaining ten were presented with the lists in the order: sentence list two, sentence list one, word list. Six subjects did the test on Nov. 24 and four on Nov. 26. Six of these subjects lived in Alberta before going to University. Two of the rest were from Toronto, one was from the Yukon, and one was from San Diego.

Ten female subjects were recruited from a first year linguistics class. They were presented the lists in the same order as the first group of 10 subjects. Eight subjects performed the test on the morning of Nov. 28 and one did it in the afternoon. All of these nine subjects were from Alberta. The tenth subject did the test on Dec. 2. This subject learned English in Australia and was phonetically trained.

These three groups of subjects will be referred to as groups one, two, and three, respectively.

D. Presentation

The ALLIGATOR programming system for psychoacoustic experimentation was used to play the sentence and word lists. They were recorded on tape. A description of the recording technique is given in Fig. 8. Every tenth item on the tape was preceded by a pronunication of its number. The tapes were played to the subjects over a TEAC model A-7030 tape recorder via a SONY model TA-1066 amplifier and the bus board in the phonetics laboratory capable of feeding fifteen sets of Telephonics model TDH-49 headphones simultaneously.

This group testing facility allowed the testing of a large number of subjects. The tape recorder's output control was set so that a 500 Hz calibration tone (at the maximum amplitude of the D/A converter) read 0 dB on the VU meter of the tape recorder. Fig. 3 is a block diagram of this setup.

E. Task

The response sheet consisted of numbered repetitions of the four possible responses, "cub, cup, cob, cop". For the first two lists the subjects were asked to circle the word used in each sentence. For the third list they were asked to circle which word they heard. Examples of the instructions and response sheets are in the appendix.

IV. Results

A. Subjects

Table 1 lists the 30 subjects and relevant details. Two subjects in each of the first two groups were rejected. One lost his place. Two skipped one question. GK performed the test twice. Since the other subjects did it only once the results of his second test could not be used. Three subjects in the last group were rejected. Two started the test late. One was phonetically trained and learned English in Australia. Table 2 lists the raw data for all the subjects. The responses "cub, cup, cob, cop" are coded "1, 2, 3, 4", respectively. If a question was not answered then a "5" is listed. The number of times each subject disagreed with the response of another subject was calculated. The resulting 30 by 30 matrix is in Table 3.

B. Words in Sentences.

Subject group three was analyzed separately from groups one and two because a preliminary analysis of variance showed significant differences. Subject groups one and two together will be referred to as section one. Subject group three will be referred to as section two. The total number of responses for each kind of response and every condition was calculated for each section. These totals are listed in Table 4. An analysis of variance was done separately on each section of subjects. The Biomedical Computer Program (Dixon, 1974) BMD08V was used with the six factors:

1. response - 4 levels - "cup, cub, cob, cop"
2. gating - 5 levels - 1, 6, 11, 16 or 21 pulses,
3. voicebar - 2 levels - absent or amplified,
4. pause - 2 levels - 64 or 128 msec
5. tone - 2 levels - stressed or unstressed "here"
6. frame - 2 levels - "The CVC could be here. " or "The big CVC could be here".

The fully crossed experimental design requires that the only terms in the analysis of variance that could be significant are interactions with the main effect, response. Table 5 lists the results for these interactions. The factor tone had no significant interactions. The factors tone, pause, and frame had no significant interactions with one another. Table 6 presents the results reorganized to reflect the fact that the factors voice, gating, and response play the most important roles. The factors pause and frame have small but significant further effects. The highest order significant interaction terms for section one are frame by voice by response and pause by voice by gate by response. The appropriate graphs to illustrate these interactions are figures 4a and 6a. For section two the highest order significant terms are frame by voice by gate by response and pause by voice by gate by response. The corresponding graphs are 5b and 6b.

Voicebar

With the amplified voicebar the majority of the responses were "cub" and "cob". With no voicebar the majority of the responses were "cup", "cop", or "cob".

Gating

The responses are clearly arranged according to the length of the vowel. As was expected, the shortest vowels were heard as "cup" or "cub", the longest as "cop" or "cob". Further, consonants following long vowels were categorized as voiced.

Pause

With a long pause following the CVC more "cop" and "cup" responses and less "cob" and "cub" responses were made.

Frame X Voice

For section one the change from the frame "The CVC could be here" to the frame "The big CVC could be here" caused;

a. an increase in the number of "cop" responses and a decrease in "cob" responses when the voicebar was absent, and

b. an increase in the number of "cub" responses and a decrease in "cup" responses when the voicebar was present.

For section two the change in frame caused:

a. an increase in the number of "cup" and "cop" responses and a decrease in the "cob" responses when the voicebar was absent, and

b. an increase in the number of "cub" and "cup" responses and a decrease in the "cob" responses when the voicebar was present.

<u>Voice X Gating X Pause</u>

Regardless of pause length or voicing the transition from /ɔ/ to /ʌ/ took place between the 11 pulse vowel and the 6 pulse vowel and did not shift more then half a pulse or 5 msec. With the amplified voicebar present, the long pause increased the number of "cup" responses for the 1 pulse vowel. With the voicebar absent, the long pause shifted the boundary between "cop" and "cob" about 4 pulses or 40 msec. The vowel duration that produced the maximum number of "cop" responses wasn't affected by the pause length.

<u>Frame X Voice X Gating</u>

For section two changing the frame to "The big CVC could be here" caused;

a. with the voicebar absent:

   1) a 2 pulse or 20 msec shift of the crossover point from "cup" to "cop",

   2) a 5 pulse or 50 msec shift of the crossover point from "cop" to "cob", and

b. with the voicebar present: a 1 pulse or 10 msec shift of the crossover point from "cub" to "cob".

These shifts all put the crossover points at longer vowel durations. The shift with the voicebar present was not merely the result of an increase in "cub" responses at the expense of "cup" responses. This is what happened at the second gating level. But at the first gating level "cup" responses increased at the expense of "cub" responses.

C. Words in Isolation

The results for words in isolation (Fig. 7) were basically the same as for the words in phrases followed by a long pause. The main difference is that the crossover from "cop" to "cob" (with no voicebar) falls nearer the upper limit of the range of vowel duration used. Also the boundary regions appear to be wider - 2 gating levels wide rather than one. A quantitative model of the categorization process would be needed to pursue this point.

V. Interpretation of Results

All of the following remarks will be made in general terms but strictly speaking the experimental results directly pertain only to word final bilabial stops following / ɔ/ within a monosyllabic word in isolation or preceding a voiceless stop. More extensive research could study the effect of the place of articulation of the final stop and various possible phonologic environments for the monosyllable.

A. Voicing

There are at least two sufficient cues to the voicing of a final stop consonant. One is the presence or absence of a strong voicebar. The other is the duration of the preceding vowel. A strong voicebar will overwhelm the effect of short duration while the absence of a voicebar makes duration the salient cue. Thus the relevance of the phonetic feature "vowel duration" as a cue to voicing is determined by the presence or absence of the voicebar. This can be put in terms of a hierarchy of cues. If the voicebar is present then the stop is percieved as voiced. Voicebar is at the top of the hierarchy. If the voicebar is absent then other cues lower in the hierarchy are used, eg. vowel duration. An equivalent formulation would claim that all the cues are processed at once but the voicebar cue is weighted more heavily than the duration cue.

B. Vowel Categorization

For the vowel under study, originally pronounced /ɔ/, duration was a sufficient cue for phonemic categorization. Future work may ask whether position in formant space and duration are weighted or traded off in a manner similar to the relation of voicebar and duration. But it is clear from these results that a straight formant theory is not sufficient.

C. Pause Length

It is logically concievable that the effect of the duration of the pause following the CVC can be described in terms of local or global factors.

Global Interpretation

The "intrinsic" duration of an English vowel phoneme is its classification as typically "long" or "short". Thus a base duration can be assigned to a phoneme, hypothetically perhaps 90 msec for /ʌ/ and 150 msec for /ɔ/. The phrase final lengthening effect requires that a vowel in the final syllable of a surface phrase be realized with an "absolute" physical duration greater than its intrinsic duration.

If a medium length vowel, say 120 msec, is to be classified as /ʌ/ or /ɔ/ on the basis of its absolute duration one would expect equal probability of both responses. But if the listener knows the vowel

occurred in the final syllable of a phrase and uses the knowledge of the phrase-final lengthening affect then the probability of the response being /ʌ / should increase. The result for the whole range of duration should be that the crossover point from /ʌ / to / ɔ/ shifts up the time scale.

If the duration of the preceding vowel is used as a cue for the voicing of a stop then phrase final lengthening should have a similar effect on the position of the crossover point from voiceless to voiced responses.

The long pause after the CVC can be conceived of as a marker of the surface (syntactic or phonologic) phrasing. Thus the long pause establishes "the CVC" and "the big CVC" as phrases and emphasizes the phrase boundary after the CVC. So the phrase-final lengthening effect should be playing a role in the perception of CVC's before the long pause. Following the arguments in the immediately preceding paragraphs the long pause should increase the number of categorizations of the vowel as /ʌ / and the consonant as "voiceless". This interpretation accounts for the effect of a longer pause in terms of a more or less global factor - the phrase boundaries within the sentence.

For section one the boundary for vowel categorization does not shift while the boundary for the voicing decision shifts 3½ pulses or 35 msec when the voicebar is absent. Thus the global interpretation's prediction that the vowel decision boundary will be affected is contradicted by experiment.

For section two with the voicebar absent the vowel boundary shifts about 2 pulses or 20 msec while the voicing boundary shifts 4 pulses or 40 msec. Since both boundaries have shifted the global interpretation is supported by experiment. A quantitative model of phrase final lengthening would be needed to exactly account for the sizes of the boundary shifts.

There is no shift in the boundary of the vowel decision when the voicebar is absent. But the number of "cup" responses does appear to increase at the expense of "cub" and "cob" responses. A quantitative theory of phrase-final lengthening that is concerned with more than just crossover or boundary points is necessary to account for this observation.

The difference between sections one and two may be one of quantity rather than one of quality. In section one with the voicebar absent there is also an increase in "cup" responses at the expense of "cub" and "cob" even though the vowel decision boundary doesn't shift. So the pause is having an effect on vowel categorization although it is not shifting the vowel categorization boundary.

Local Interpretation

If the pause length is interpreted as a local phonologic cue then the restriction of its affect to the voicing of the consonant is acceptable. But the explanation of its effect can no longer rely on vowel length as an intermediate step. The simplest hypothesis is that a long pause after a word-final stop is a deliberate and independent cue for the

feature voicing. Thus, the cues for the voicing of a stop depend on the phonological and perhaps even morphological context. An alternative hypothesis could claim that there is a single physiological correlate of voicing perhaps "force of articulation", intrabuccal pressure, or glottal posture. Then the acoustic cues in different contexts are supposed to arise from the physiological limitations of the articulators. Such a hypothesis remains speculation without corresponding physiological evidence.

Synthesis

The fact that the long pause does shift the vowel boundaries for section two and has an effect on vowel categorization for both sections is evidence against a strict local interpretation. It may be the case that both interpretations are partly correct. One cannot say how much of the silence is a phrase-marking pause and how much of it is a narrow phonological cue. The fact that there is a much stronger affect on voicing than on the vowel suggests that most of the pause is being interpreted as a local phonological cue to voicing alone. The weaker effect on the vowel categorization suggests that some effect of phrasing is occurring.

D. Frame

Klatt (1976) reported that Goldhor's data suggested that a single noun as a subject formed a single surface phrase with the verb. The

presence of an adjective was sufficient to set off the subject as a single phrase. The criteria for the existence of a phrase was the existence of the phrase-final boundary lengthening effect. If 1) the listener uses information derived from word order and grammatical class (or from phonological cues other than timing) to infer when phrase-final lengthening has occurred and if 2) "the CVC could" and "the big CVC" form surface phrases then the presence of phrase final lengthening in "the big CVC" should produce a shift to / / and voiceless quality.

Phrasing Interpretation

The clear shifts in boundaries found for section two follow the predictions of the preceding paragraph. There is the question, though, of why the shift in the voicing boundary should be larger than the shift in the vowel boundary. A more quantitative model of the effect of phrasing on timing would be necessary to resolve this problem.

Semantic Interpretation

The voice by frame interaction for section one can be given a semantic explanation. The two words "cub" and "cop" describe animate beings that are often classified as large or small. The two words "cob" and "cup" describe inanimate objects whose size is more or less standard. A variety of word association tests could test the hypothesis that "big" is more strongly associated with "cub" and "cop" than with "cup" or "cob". The phonological factors remain the main determiners of the subjects'

responses. Thus the response "cub" was rarely given when the voicebar was absent. So there was no opportunity for the semantic effect of the frame "The big CVC could be here" to exert an influence and increase "cub" responses. But the semantic effect did increase the "cop" responses over the "cob" responses. With the voicebar present there were few "cop" responses. But the semantic effect of the second frame did increase the "cub" responses at the expense of "cup" responses.

This interpretation cannot account for the results of section two. Both with and without voicebar the second frame increased "cup" responses while decreasing "cob" responses.

E. Section Differences

On the whole, section one appeared to be less sensitive to phonologic and syntactic context and more sensitive to semantic context and obvious phonological cues than section two.

F. Intonation

The strong intonation cue for stress on "here" hypothetically could have weakened the perceived stress on the CVC and thus shortened the length that would have been acceptable as an intrinsically long vowel. But the absence of any effect is not surprising since "here" is the third word past the CVC.

G. Words in Isolation

The results for the words in isolation are accounted for in the same manner as the results for the CVC's followed by long pauses. The boundaries for the vowel phoneme categorization are the same for the words in isolation and the words in phrases. But the boundary for the voicing decision is shifted. If the listeners expected different vowel lengths in isolated words then the boundaries for both the vowel and the voicing categorizations would shift. So the vowel categorization appears to be based on the absolute length of the vowel. But the voicing decision is based on the length of the vowel in relation to the context.

The broader boundaries for the isolated words indicate that the listener either 1) can make a more categorical decision while processing a phrase or 2) uses the rest of the phrase as a reference to make more accurate measurements of absolute duration.

H. Summary

In summary, the regions of the speech signal used in processing vowel quality and the feature voicing have been found to be much narrower than suggested by production measurements. The perceptual relevance of vowel duration and the presence of a voicebar is easily separated from and much greater than the relevance of a following pause or the choice of a syntactic frame. The intonation pattern on the end of the phrase had no relevance for the perception of a vowel at the beginning of the phrase.

Vowel length is a sufficient cue for changing the phonemic categorization of a vowel sound. So a straight formant theory of the perception of English vowel phonemes is not sufficient. Vowel duration must be included in any theory of English vowel perception. The presence of a strong voicebar did eliminate the effect of vowel duration on the perception of voicing in the following consonant. The phrase context did slightly shift the position of perceptual boundaries and would have to be taken into account in any attempt at establishing an accurate quantitative theory beyond a first order of approximation.

VI. Suggestions for Further Study

An obvious future step is the use of synthetic speech signals. The vowel formants could then be systematically varied. It would be expected that duration cues to vowel quality would be more relevant for perception when a vowel sound was on a boundary in formant space between two vowel categories. The trade-off between position in formant space and vowel duration would be expected to be similar to the trade-off between vowel duration and voicebar intensity. Variation of synthetic distractor stimuli might allow investigation into the role that speaker normalization plays in the results. A wider variety of distractor stimuli that are not similar to the experimental stimuli would provide better experimental control. Variation of the intonation contours of synthetic stimuli would allow a more detailed investigation of the effect of stress intonation and phrasing intonation on vowel categorization.

A second possible future step would be to integrate a cognitive task into the perceptual experiment. This would allow manipulation of the subjects' expectations based on semantic context and content. An intellectually more demanding task would allow more data to be collected from a subject before a boredom limit was reached.

In general, future extensions of the basic experiment would require the collection of more data from more subjects. The present study used groups of subjects rather than a single subject at a time. Future work could aim towards on-line (rather than manual) data collection by computer

from a large group of subjects. The ability to rapidly collect and process a large amount of data would allow a more complete experimental design. Extensions in this direction could include the use of more than one vowel opposition and a variety of phonologic environments. Word lists such as those prepared by Lehiste and Peterson (1959), Rockey (1973), and Moser (1969) would be valuable in preparing stimulus material.

Even without the addition of further experimental variables, the collection of a larger volume of data would be necessary to develop a more quantitative theory. Finer division of the ranges of vowel duration, pause duration, voicebar duration, and voicebar intensity would be important in developing an accurate quantitative model. A quantitative mathematical model of the perceptual categorization of vowel quality could be based on statistical decision theory and/or feature detection. Such a model ought to be consistent with measurements of actual speech and with the results of the perceptual experiments.

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List of Tables

TABLE 1 SUBJECTS

No.	Initials	Previous Residence	Comments
1	JM	Grand Centre, Alta	also Ontario, Germany
2	GS	Red Deer, Alta.	
3	PE	Wembley, Alta.	
4	KR	Beaverlodge, Alta.	
5	JT	Calgary, Alta.	
6	DS	Calgary, Alta.	also Los Angeles
7	BC	Alberta	
8*	GK	New Dayton, Alta.	missed #28, part 2
9	OC	Lethbridge, Alta.	
10*	BK	Hinton, Alta.	lost place #10, part 2
11	MD	Toronto, Ontario	
12	CG	Alberta	
13	PK	Toronto, Ontario	
14	BN	Yukon, Northwest Terr.	
15	PW	San Diego, California	
16*	GK	same person as #8	
17	RM	Alberta	
18	SP	Ponoka, Alta.	also Ontario
19	DM	Alberta	
20*	RD	Alberta	missed #13, part 3
21		Alberta	
22		Edmonton, Alta.	
23		Edmonton, Alta.	
24		Edmonton, Alta.	
25		Hinton, Alta.	
26		Alberta	
27*		Alberta	started late
28*		Edmonton, Alta.	started late
29		Alberta	missed #1, part 3
30*		Malaya, Australia	phonetically trained

* Results not used.

TABLE 2a) RESULTS FOR SENTENCE LIST 1

Ques. No.	SUBJECT NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
12	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
13	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
14	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
15	4	4	3	4	3	4	4	4	3	3	3	4	4	4	4
16	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1
17	1	1	1	1	1	3	1	1	1	1	2	1	2	1	1
18	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4
19	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
20	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
21	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
22	3	3	3	3	3	3	4	4	3	3	3	3	3	3	4
23	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
24	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
25	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
26	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
27	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
28	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
29	4	4	4	4	3	4	4	4	4	3	4	4	4	4	4
30	1	3	1	1	1	3	1	1	1	1	3	1	1	1	1
31	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
32	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3
34	3	4	3	4	4	4	4	3	3	3	3	3	4	4	3
35	1	1	1	3	4	1	1	1	1	1	1	1	1	1	1
36	1	1	1	1	1	3	1	1	1	1	3	1	2	1	2
37	4	4	4	4	4	4	4	3	4	3	4	4	4	4	4
38	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
39	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3
40	4	1	2	2	2	4	4	2	2	2	4	2	2	2	4
41	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 = CUB
2 = CUP
3 = COB
4 = COP
5 = Not answered

TABLE 2a) Cont.

Ques. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	SUBJECT NO.														
42	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
43	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
45	4	4	4	4	4	4	4	4	4	3	3	4	3	4	4
46	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
47	4	4	3	4	3	4	4	4	4	3	4	4	4	3	3
48	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
49	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
51	2	2	2	4	2	4	2	2	2	2	4	2	4	2	2
52	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
53	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
54	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
55	3	3	3	4	3	3	3	3	3	3	3	3	1	3	1
56	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
57	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3
58	3	4	4	4	4	4	4	4	3	4	3	4	2	3	4
59	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
60	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
61	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
62	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
63	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
64	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
65	4	4	3	4	3	3	4	3	3	3	3	3	4	3	3
66	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
67	3	3	3	3	3	3	4	3	3	3	3	3	4	3	3
68	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
69	1	2	1	1	2	1	1	2	1	1	1	1	1	2	1
70	3	4	4	4	3	4	3	3	4	3	3	4	4	3	4
71	3	3	3	3	3	3	3	3	3	3	3	3	1	4	3
72	2	2	2	4	2	4	2	2	2	2	1	2	2	2	2
73	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
74	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
75	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3
76	2	2	2	2	2	4	2	2	2	2	4	2	2	2	2
77	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
78	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
79	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
80	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
81	4	4	3	3	3	4	4	3	4	3	3	4	4	3	4
82	4	4	4	4	3	4	4	4	4	4	3	4	4	4	3
83	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4
84	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
85	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
86	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
87	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
88	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
89	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1

TABLE 2a) Cont.

Ques. No.	SUBJECT NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
90	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2
91	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
92	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
93	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4
94	2	2	2	2	2	4	2	2	2	2	2	2	1	2	2
95	3	3	3	3	3	3	3	1	3	3	1	3	3	3	3
96	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
97	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2
98	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
99	1	1	1	3	1	1	2	1	1	1	1	1	2	1	1
100	3	3	3	3	3	3	4	3	3	3	3	3	4	3	3
101	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4
102	4	4	4	4	4	4	4	4	4	3	4	4	3	4	4
103	3	4	3	3	3	4	4	4	3	3	3	3	3	3	3
104	4	4	4	4	2	4	4	4	4	4	2	4	1	4	4
105	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2
106	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
107	3	3	3	4	4	4	4	4	3	3	3	4	3	4	4
108	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
109	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 2a) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	4	4	4	4	4	3	4	4	3	4	4	5	5	3	3
2	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
3	1	1	1	1	1	1	1	2	1	1	1	5	5	1	1
4	2	2	2	2	2	2	2	2	2	2	2	5	5	2	2
5	1	1	1	1	1	1	2	1	1	1	1	5	5	2	1
6	2	2	2	2	2	2	2	2	2	2	2	5	5	2	2
7	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
8	4	4	4	4	4	4	4	4	4	4	4	5	5	4	4
9	1	4	1	1	1	1	1	3	3	1	1	5	5	3	3
10	5	3	3	3	3	3	3	3	3	3	3	5	5	3	3
11	3	2	2	2	2	2	2	2	2	2	2	5	5	3	4
12	2	3	3	3	3	3	3	3	3	3	3	5	5	2	3
13	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
14	3	3	3	3	3	3	3	4	3	3	3	5	5	3	3
15	3	4	4	3	4	4	3	3	3	4	4	5	5	3	3
16	4	1	1	1	1	1	1	1	2	1	1	5	5	3	4
17	1	2	1	1	1	1	1	3	3	1	1	5	5	1	4
18	1	4	4	4	4	4	3	3	4	4	4	5	5	1	3
19	4	3	3	3	3	3	3	3	3	3	3	5	5	3	3
20	4	4	4	4	4	4	4	4	4	4	4	4	5	3	4
21	2	2	2	2	2	2	2	2	2	2	2	2	5	2	2
22	3	3	4	3	3	3	3	3	3	3	3	3	5	3	3
23	1	1	1	1	1	1	3	3	3	1	1	5	5	3	4
24	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
25	4	4	4	4	4	4	3	4	4	4	4	5	5	3	3
26	1	1	1	1	1	1	2	1	2	1	1	5	5	2	1
27	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3
28	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2
29	4	4	4	4	4	4	3	4	4	3	4	1	3	3	3
30	2	1	1	1	1	2	2	2	2	1	1	2	2	2	4
31	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
32	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2
33	3	3	4	3	4	3	3	3	3	3	3	3	3	3	3
34	3	4	4	3	4	4	3	3	3	3	3	3	3	3	3
35	1	1	1	1	1	1	2	1	1	1	1	1	2	2	4
36	1	1	1	1	1	3	3	3	3	1	1	4	3	1	4
37	4	4	4	4	4	4	4	3	4	4	4	5	3	3	3
38	4	4	4	4	4	4	4	4	4	4	4	3	3	3	4
39	3	3	3	3	3	3	3	3	3	3	4	4	3	3	3
40	2	4	2	4	2	2	2	2	3	4	4	3	3	2	4
41	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

TABLE 2a) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
42	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2
43	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
45	4	4	4	4	4	4	3	4	4	4	4	4	4	3	3
46	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
47	3	4	3	3	4	4	3	3	4	4	4	3	3	3	3
48	1	1	1	1	1	1	1	3	1	1	1	4	1	1	4
49	2	2	2	2	2	2	2	2	2	2	2	1	2	2	4
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
51	2	2	2	2	2	4	2	2	4	2	1	4	1	1	4
52	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
53	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4
54	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3
55	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
56	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
57	3	3	3	3	3	4	3	3	3	3	4	3	3	3	3
58	4	4	4	4	4	4	3	4	4	4	4	4	4	3	3
59	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4
60	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
61	1	1	1	1	1	1	1	1	2	1	1	3	2	1	3
62	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
63	2	2	4	4	2	2	2	4	2	2	4	4	2	2	4
64	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
65	4	4	4	4	3	4	3	4	3	3	4	4	3	3	3
66	1	2	1	1	1	1	2	2	1	2	1	1	2	2	4
67	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3
68	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2
69	1	1	1	1	1	2	1	1	2	2	1	1	1	1	2
70	4	4	4	3	4	4	3	3	3	4	4	3	3	3	3
71	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
72	2	2	2	2	2	2	2	4	2	2	4	4	2	2	4
73	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4
74	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3
75	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
76	2	2	2	2	2	4	2	4	4	2	2	4	4	2	4
77	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
78	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4
79	3	3	3	3	3	3	1	3	3	3	3	3	3	3	3
80	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
81	4	4	4	3	3	4	3	3	3	3	4	3	3	3	3
82	4	4	4	4	4	4	3	4	4	4	4	3	4	3	3
83	4	4	3	4	4	4	4	4	3	4	4	4	4	3	3
84	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
85	1	1	1	1	1	1	1	1	3	1	1	2	1	1	4
86	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
87	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
88	3	3	3	3	3	3	3	3	3	4	3	4	3	3	3
89	1	2	1	1	1	1	1	1	1	2	1	1	1	1	3

TABLE 2a) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
90	2	2	2	2	2	2	2	2	2	2	2	2	1	2	4
91	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
92	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
93	4	4	4	4	4	4	4	4	3	4	4	4	4	3	3
94	2	2	2	4	2	4	4	4	4	2	4	4	2	4	4
95	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
96	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
97	2	2	2	2	2	2	2	2	2	2	2	4	2	2	4
98	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
99	1	4	1	1	1	1	2	2	1	2	1	1	1	2	4
100	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3
101	4	4	4	4	4	4	3	4	3	4	4	4	4	3	3
102	4	4	4	4	4	4	3	4	3	4	4	3	3	3	3
103	3	4	4	3	4	4	3	3	4	3	4	3	3	3	3
104	4	2	4	4	4	4	4	4	4	4	3	4	4	3	2
105	2	2	2	2	2	4	1	2	2	2	2	2	2	2	4
106	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
107	3	4	4	3	4	4	3	3	3	4	4	3	3	3	4
108	1	1	1	1	1	1	1	1	1	1	1	4	1	1	4
109	1	1	1	1	1	1	1	1	1	2	1	1	1	1	4

TABLE 2b) RESULTS FOR SENTENCE LIST 2

Ques. No.	SUBJECT NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
9	3	3	3	3	3	3	4	4	3	3	3	3	3	3	4
10	1	1	1	2	2	1	1	1	1	1	1	1	2	2	1
11	1	1	1	1	1	1	1	1	1	1	3	1	1	4	3
12	4	3	4	4	4	4	4	4	3	2	3	4	4	4	4
13	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
14	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
15	1	1	1	1	1	1	1	1	1	1	3	1	2	1	1
16	3	3	3	3	3	3	4	3	3	3	3	3	3	3	4
17	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
18	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
19	3	3	3	3	4	3	3	3	3	3	3	3	3	1	1
20	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
21	3	4	3	4	4	3	4	4	3	3	3	4	3	3	4
22	3	3	3	3	4	3	3	3	1	3	3	3	3	3	3
23	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
24	2	1	2	2	2	4	2	2	2	2	2	4	4	4	1
25	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
26	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1
27	4	4	3	3	3	4	4	4	3	3	3	3	3	3	4
28	1	1	1	2	1	1	1	5	1	1	1	1	2	1	2
29	3	3	3	3	3	3	3	1	3	3	3	3	3	3	3
30	2	1	2	2	2	4	4	3	2	2	3	4	4	2	2
31	3	3	3	3	4	3	3	2	3	3	3	3	3	3	3
32	2	2	2	2	2	2	2	3	2	2	1	2	2	2	2
33	4	4	4	4	4	3	4	2	4	3	3	4	3	3	4
34	4	4	3	4	3	3	4	4	3	3	3	3	3	3	3
35	1	1	1	1	2	1	1	4	1	1	1	1	4	1	1
36	4	3	3	4	4	3	4	1	3	3	3	3	3	3	3
37	1	1	1	1	1	1	1	3	2	1	3	1	3	1	1
38	4	4	4	4	2	4	4	1	4	4	4	4	2	4	4
39	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3
40	4	4	4	4	4	4	4	3	4	3	3	4	2	4	4
41	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2

1 = CUB
2 = CUP
3 = COB
4 = COP
5 = NOT ANSWERED

TABLE 2b) Cont.

Ques. No.	SUBJECT NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
42	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
43	2	2	2	2	2	4	2	3	2	2	4	2	2	2	2
44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
45	3	3	3	3	4	3	4	2	3	3	3	3	1	3	3
46	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
47	2	2	2	2	2	4	2	3	2	2	2	4	4	2	2
48	1	1	1	2	1	1	1	2	1	1	1	1	2	1	1
49	4	4	4	4	3	4	4	1	3	3	3	4	4	3	4
50	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3
51	4	3	3	3	4	3	4	3	3	3	3	3	4	3	4
52	4	4	3	4	4	3	4	3	3	3	3	3	4	4	3
53	1	1	1	1	1	1	1	4	1	1	1	1	1	1	1
54	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2
55	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
56	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
57	1	1	1	2	2	1	1	1	1	1	1	1	2	1	2
58	4	4	4	4	4	4	4	1	4	3	4	4	4	4	4
59	3	4	3	3	3	3	4	4	3	3	4	3	4	3	3
60	2	2	2	2	2	4	2	2	3	2	2	2	4	4	2
61	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
62	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
63	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4
64	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
65	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
66	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
67	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
68	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
69	4	4	3	4	4	3	4	4	4	3	4	4	4	4	4
70	2	1	1	2	2	1	2	1	1	5	1	1	1	1	1
71	4	4	4	4	4	4	4	4	4	1	4	4	4	3	4
72	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3
73	4	3	3	3	4	3	4	4	3	3	3	4	3	3	3
74	4	4	4	4	4	4	4	4	4	3	4	4	2	4	4
75	1	1	1	1	1	3	1	1	1	4	1	1	1	1	1
76	4	4	3	4	4	4	4	4	3	1	3	4	4	3	4
77	2	1	1	2	2	1	1	1	1	3	2	2	2	2	2
78	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1
79	2	2	1	2	2	2	2	2	2	1	1	2	2	2	2
80	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
81	4	4	3	3	4	4	4	4	3	3	3	4	4	4	4
82	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
83	4	3	3	4	4	4	4	4	3	3	3	3	4	3	4
84	3	3	3	3	4	3	3	3	3	3	3	3	1	3	3
85	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
86	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
87	4	4	4	4	4	4	4	4	4	2	4	4	3	3	3
88	1	1	1	1	2	1	1	1	1	3	1	1	1	1	1
89	1	1	1	1	4	1	1	1	1	1	1	1	1	3	1

TABLE 2b) Cont.

Ques.	SUBJECT NO.														
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
90	4	4	3	4	4	4	4	4	3	4	4	4	4	3	4
91	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
92	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
93	3	3	3	1	1	3	1	3	1	3	3	3	4	3	1
94	3	3	3	3	1	3	3	3	3	3	3	3	1	3	3
95	2	2	2	2	2	4	2	2	2	2	1	2	2	2	2
96	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
97	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
98	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
99	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
100	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
101	4	3	3	4	3	3	4	4	4	3	3	4	4	3	4
102	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
103	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
104	4	4	1	4	4	4	4	4	4	2	4	4	4	4	4
105	2	2	2	4	2	4	4	2	2	2	1	2	2	2	2
106	3	3	3	3	1	3	3	3	3	3	3	3	4	3	3
107	4	4	3	3	4	3	4	4	3	3	3	3	1	3	3
108	2	2	4	2	2	4	2	2	2	2	2	2	2	2	2
109	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3

TABLE 2b) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	4	4	4	4	4	4	4	4	3	4	4	5	3	4	2
2	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
3	1	1	1	1	1	1	1	1	1	1	1	5	5	1	1
4	2	2	2	2	2	2	2	2	2	2	2	5	5	2	2
5	1	1	1	1	1	1	1	1	2	1	1	5	2	1	2
6	2	2	2	2	2	2	2	2	2	2	2	5	1	2	2
7	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3
8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
9	4	3	3	3	4	4	3	4	3	3	4	3	3	3	3
10	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1
11	1	1	3	1	2	1	1	3	3	1	1	3	1	1	3
12	4	4	4	4	4	4	4	4	3	4	4	1	3	3	3
13	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
14	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3
15	1	2	1	1	2	1	1	1	1	1	1	1	1	1	4
16	3	3	3	3	4	3	3	3	3	3	4	3	3	3	3
17	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2
18	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
19	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
20	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
21	4	3	3	3	4	4	4	4	3	4	4	3	3	3	3
22	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
23	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
24	4	2	2	4	2	4	2	4	4	4	1	4	1	2	4
25	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
26	1	1	1	1	1	1	1	1	2	1	1	1	1	2	2
27	4	4	3	3	4	4	3	4	3	3	4	3	3	3	3
28	1	1	1	1	1	1	1	1	1	1	1	2	2	1	2
29	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
30	2	4	4	4	4	4	2	4	4	4	4	4	1	2	3
31	3	3	3	3	3	4	1	3	3	3	3	3	3	3	3
32	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	4	4	4	3	4	4	4	3	3	3	3	4	3	3	3
34	4	3	3	3	4	3	3	3	4	3	4	3	3	3	3
35	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
36	3	3	4	3	4	4	3	4	3	3	4	3	3	3	3
37	1	2	1	1	3	1	1	1	1	1	1	3	1	1	4
38	3	2	4	4	4	4	4	4	4	4	4	4	4	4	2
39	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
40	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
41	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4

TABLE 2b) ont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
42	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
43	2	2	2	2	2	2	2	2	2	2	2	4	2	2	4
44	2	2	2	2	2	1	2	2	2	2	2	2	1	2	2
45	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
46	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
47	2	2	2	3	4	4	2	2	2	2	4	4	1	2	4
48	1	2	1	1	1	1	2	2	2	1	1	1	1	1	2
49	4	3	4	3	4	4	3	4	3	4	4	3	3	3	3
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
51	3	4	3	3	4	4	3	3	3	3	4	3	3	3	3
52	4	3	4	3	4	4	4	4	3	4	3	3	3	3	3
53	1	1	1	1	1	1	1	1	2	1	1	4	1	2	4
54	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
55	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
56	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
57	1	2	1	1	1	1	1	2	2	2	1	2	1	1	2
58	4	4	4	4	4	4	4	4	4	4	4	3	4	3	3
59	4	3	3	3	4	4	3	3	3	3	3	3	3	3	3
60	2	2	2	2	2	4	2	4	2	2	2	4	2	2	4
61	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
62	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2
63	4	4	4	4	4	4	4	3	4	4	4	3	4	3	4
64	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
65	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
66	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
67	1	2	1	1	1	1	1	2	3	1	1	4	1	3	3
68	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
69	4	4	4	4	4	4	3	4	4	4	4	4	4	3	3
70	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2
71	4	4	4	4	4	4	4	4	4	3	4	4	4	3	3
72	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
73	4	3	3	3	3	4	3	4	3	3	3	3	3	3	3
74	4	1	4	4	4	4	4	4	4	4	4	4	4	4	4
75	1	2	1	1	1	1	1	1	1	1	1	3	1	1	3
76	4	4	3	4	4	4	4	4	4	4	4	3	3	3	3
77	2	2	2	2	2	1	1	2	2	2	1	2	1	1	4
78	1	3	1	1	1	1	1	1	1	1	1	1	1	1	4
79	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
80	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
81	4	3	3	3	4	4	4	4	4	4	4	3	3	3	3
82	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
83	4	1	3	3	3	3	4	3	3	3	3	3	3	3	3
84	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
85	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4
86	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
87	4	3	4	4	4	4	4	4	4	3	4	3	4	3	3
88	1	1	1	1	1	2	1	2	1	1	1	1	1	1	4
89	1	1	3	1	1	1	1	3	3	1	1	3	3	3	4

TABLE 2b) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
90	4	4	4	3	4	4	4	4	4	4	4	4	3	3	4
91	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3
92	3	1	3	3	3	3	3	3	3	4	3	4	3	3	3
93	3	4	3	3	3	3	1	3	3	3	3	3	3	3	3
94	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
95	2	2	2	4	2	2	2	4	4	2	4	4	2	4	4
96	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4
97	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
98	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
99	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
100	1	1	1	1	1	1	1	2	3	1	1	3	1	1	3
101	4	4	3	3	4	4	4	4	3	4	4	3	3	3	3
102	1	1	1	2	1	1	1	1	1	1	1	2	1	1	4
103	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
104	2	2	4	4	4	4	4	4	4	4	4	4	4	4	1
105	2	2	2	2	2	4	2	2	4	1	4	3	2	1	4
106	3	4	3	3	3	3	3	3	3	4	3	3	3	3	3
107	4	3	4	3	4	4	3	3	3	4	4	3	3	3	3
108	2	2	2	2	2	4	2	2	4	2	4	4	1	2	4
109	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3

TABLE 2c) RESULTS FOR WORD LIST

Ques.	SUBJECT NO.														
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	2	2	4	4	2	2	2	2	2	4	2	2	2	2
2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	2	2	4	4	2	4	2	2	2	4	2	4	2	4	4
9	1	1	1	1	2	3	1	1	1	1	1	1	1	1	1
10	4	4	3	4	3	4	4	4	3	3	3	4	4	3	4
11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
12	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
13	3	1	3	1	3	3	1	1	1	3	1	3	1	3	1
14	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
15	4	4	3	4	3	4	4	4	3	3	3	4	4	4	4
16	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
18	4	2	4	4	4	4	2	4	4	3	3	4	3	4	2
19	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
20	2	2	2	2	2	4	2	2	2	2	2	2	2	2	4
21	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2
22	3	4	3	4	3	4	4	3	3	3	3	3	3	3	3
23	1	1	1	1	1	3	1	2	1	1	1	1	1	1	1
24	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
25	4	4	4	4	4	4	4	4	4	3	1	4	4	4	4
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
28	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
29	4	1	4	4	4	4	4	4	4	3	3	4	4	4	4
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
31	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
32	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	4	4	3	4	3	3	4	3	3	3	3	3	4	4	3
34	4	4	4	4	3	3	4	3	4	3	3	4	3	4	4
35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
37	4	2	4	4	4	4	4	4	4	3	3	4	4	4	4
38	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4
39	3	3	3	1	3	3	1	3	3	3	3	3	3	3	3
40	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
41	3	3	3	1	3	3	3	3	3	3	3	3	3	3	3

1 = CUB
2 = CUP
3 = COB
4 = COP
5 = NOT ANSWERED

TABLE 2c) Cont.

Ques. No.	SUBJECT NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
42	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
43	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
45	4	4	4	4	4	4	2	4	4	3	3	4	4	4	4
46	4	3	3	4	3	4	4	3	3	3	3	3	3	3	3
47	4	4	4	2	3	4	4	4	4	3	4	4	3	3	4
48	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
49	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
51	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
52	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
53	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
54	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
55	3	1	3	1	3	3	1	3	1	3	3	3	1	3	1
56	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
57	3	1	3	3	3	3	1	3	1	3	3	3	4	3	3
58	4	4	4	4	3	4	4	4	4	3	1	4	4	4	4
59	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
60	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
61	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 2c) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	2	2	2	2	4	2	4	4	2	4	4	2	5	2
2	3	3	3	3	3	3	1	3	3	3	3	3	3	3	2
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3
8	2	2	2	2	2	4	4	4	2	4	4	4	4	4	2
9	1	1	1	1	1	1	1	3	1	1	1	1	1	1	2
10	4	3	4	3	4	3	3	3	3	4	4	3	3	3	1
11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
12	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
13	3	3	3	3	1	3	1	3	1	3	3	4	1	3	3
14	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
15	4	4	4	3	4	4	3	3	3	4	4	3	3	3	3
16	1	1	1	1	1	1	2	2	1	1	1	2	1	1	1
17	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
18	4	2	4	4	4	4	1	4	4	2	4	4	2	4	1
19	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
20	2	2	2	2	2	4	2	2	2	2	4	4	2	2	2
21	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2
22	3	3	3	3	4	3	3	4	3	4	4	3	4	3	1
23	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
24	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
25	4	4	4	4	2	4	2	4	4	4	4	4	2	4	1
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
28	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
29	4	4	4	3	4	4	4	4	4	4	4	4	4	4	1
30	1	2	1	1	1	1	1	1	1	1	1	4	1	1	2
31	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
32	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	4	3	3	3	3	4	3	3	4	4	4	3	3	3	1
34	4	3	4	4	4	4	4	4	3	4	4	4	3	4	1
35	1	1	1	1	1	2	1	2	1	1	1	2	1	1	2
36	1	1	1	1	1	5	1	1	1	1	1	4	1	1	2
37	4	4	4	4	2	4	4	4	4	2	4	2	2	4	1
38	2	2	2	2	1	4	2	2	4	2	4	4	4	4	1
39	3	3	3	3	5	3	1	3	3	1	3	3	3	3	1
40	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
41	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1

TABLE 2c) Cont.

Ques. No.	SUBJECT NO. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
42	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
43	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
45	4	4	4	3	4	4	2	4	4	4	4	4	1	4	2
46	4	3	3	3	3	3	4	4	4	4	3	3	2	3	1
47	4	4	4	3	4	4	4	4	4	4	4	4	2	4	1
48	1	1	1	1	1	1	1	2	1	1	1	3	1	1	1
49	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
50	3	3	3	3	3	3	1	3	3	3	3	3	3	3	1
51	2	2	2	2	2	2	2	2	4	2	2	2	1	2	2
52	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
53	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
54	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
55	1	3	3	3	1	3	1	3	3	3	4	4	1	3	1
56	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
57	3	3	3	3	3	3	1	3	3	1	3	3	1	3	1
58	4	4	4	4	4	4	4	4	4	4	4	3	3	4	1
59	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
60	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
61	1	1	1	1	1	4	2	1	1	1	1	4	1	1	1

TABLE 3 NO. DISAGREEMENTS BETWEEN SUBJECTS

SUBJ. A	SUBJECT B. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0	27	31	36	47	45	24	48	31	58	57	20	56	36	33
2	27	0	37	44	61	46	28	52	33	64	58	28	59	43	36
3	31	37	0	47	52	44	51	58	20	39	48	21	69	31	38
4	36	44	47	0	57	57	39	67	47	75	73	38	60	51	44
5	47	61	52	57	0	75	59	70	55	68	73	49	74	51	57
6	45	46	44	57	75	0	53	67	53	72	63	35	70	53	56
7	24	38	51	39	59	53	0	52	45	77	73	36	59	56	37
8	48	52	58	67	70	67	52	0	58	78	72	45	77	65	57
9	31	33	20	47	55	53	45	58	0	51	47	25	62	36	38
10	58	64	39	75	68	72	77	78	51	0	56	51	84	54	66
11	57	58	48	73	73	63	73	72	47	56	0	54	77	60	64
12	20	28	21	38	49	35	36	45	25	51	54	0	54	30	26
13	56	59	69	60	74	70	59	77	62	84	77	54	0	60	58
14	36	43	31	51	51	53	56	65	36	54	60	30	60	0	41
15	33	38	38	44	57	50	37	57	38	66	64	26	58	41	0
16	23	31	37	46	58	55	37	54	40	65	69	27	63	47	39
17	43	50	46	55	62	57	53	68	46	68	67	40	54	52	47
18	26	31	27	42	52	47	38	55	31	58	58	22	63	33	37
19	33	41	24	54	52	47	52	61	30	44	46	26	65	33	45
20	31	28	42	42	60	52	30	49	41	70	63	27	60	47	35
21	42	42	51	58	64	45	42	65	56	83	75	36	65	52	51
22	53	58	46	61	64	67	58	76	46	62	67	51	79	61	56
23	54	64	55	63	67	54	66	79	64	78	73	50	81	57	63
24	59	59	57	68	73	52	73	79	57	76	58	56	81	59	68
25	36	35	41	44	62	52	41	65	47	65	68	28	61	40	42
26	35	38	46	69	71	40	38	62	51	77	72	32	68	54	39
27	119	122	108	120	126	106	134	139	113	122	12	110	133	111	113
28	94	83	74	98	106	94	101	110	78	88	89	85	115	86	90
29	72	78	51	83	81	77	91	94	57	65	66	66	97	60	77
30	133	132	120	128	130	116	140	143	122	120	10	128	136	122	132

TABLE 3 Cont.

SUBJ. A	SUBJECT B. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	23	43	26	33	31	42	53	54	59	36	35	119	94	72	133
2	31	50	31	41	28	42	58	64	59	35	38	122	83	78	132
3	37	46	27	24	42	51	46	55	57	41	46	108	75	51	120
4	46	55	42	54	42	58	61	63	68	44	49	120	98	83	128
5	58	62	52	52	60	64	64	67	73	62	71	126	106	81	130
6	55	57	47	47	52	45	67	54	52	52	40	106	94	77	116
7	37	53	38	52	30	42	58	66	73	41	38	134	101	91	140
8	54	68	55	61	49	65	76	79	79	65	62	139	110	94	143
9	40	46	31	30	41	56	46	64	57	47	51	113	78	57	122
10	65	68	58	44	70	83	62	78	76	65	77	112	88	65	120
11	69	67	58	46	63	75	67	73	58	68	72	112	89	60	110
12	27	40	22	26	27	36	51	50	56	28	32	110	85	66	128
13	63	54	63	65	60	65	79	81	81	61	68	133	115	97	136
14	47	52	33	33	47	52	61	57	59	40	54	111	86	60	122
15	39	47	37	45	36	51	56	63	68	42	39	113	90	77	132
16	0	55	37	42	38	48	58	57	67	45	46	121	94	75	137
17	55	0	44	49	50	64	73	69	72	48	58	126	104	84	129
18	37	44	0	31	30	46	63	56	60	42	41	112	90	68	129
19	42	49	31	0	47	56	55	51	52	45	44	102	80	59	117
20	38	50	30	47	0	44	63	64	69	42	36	124	96	86	137
21	48	64	46	56	44	0	72	58	64	55	35	117	104	86	137
22	58	73	63	55	63	72	0	63	69	58	75	124	86	58	118
23	57	69	56	51	64	58	63	0	60	60	60	105	98	74	125
24	67	72	60	52	69	64	69	60	0	66	64	102	83	59	106
25	45	48	42	45	42	55	58	60	66	0	47	121	92	74	124
26	46	58	41	44	36	35	75	60	64	47	0	115	100	78	135
27	121	126	112	102	124	117	124	105	102	121	115	0	85	108	133
28	94	104	90	80	96	104	86	98	83	92	100	85	0	82	139
29	75	84	68	59	86	86	58	74	59	74	78	08	82	0	104
30	137	129	129	117	137	137	118	125	106	124	135	133	139	104	0

TABLE 4a) TOTAL NO. RESPONSES FOR ALL CONDITIONS - SECTION 1.

Falling tone and no voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	0	32	0	0	0	32	0	0	1	31	0	0	0	32	0	0
6	1	19	1	11	2	26	0	4	0	26	0	0	0	27	1	4
11	0	0	7	25	0	0	3	29	0	0	2	30	0	1	1	30
16	1	0	18	13	0	1	10	21	0	0	15	17	0	0	6	26
21	10	0	26	6	0	0	18	14	1	0	21	10	0	0	18	14

Falling tone and a voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	27	5	0	0	18	14	0	0	28	1	1	2	24	6	1	1
6	26	0	5	1	27	3	2	0	28	2	2	0	28	2	2	0
11	2	0	29	1	2	0	28	2	0	0	31	1	1	0	29	2
16	0	0	32	0	1	0	30	1	0	0	32	0	0	0	31	1
21	0	0	32	0	0	0	32	0	0	0	32	0	1	0	31	0

TABLE 4a) Cont.

Final stress and no voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	2	30	0	0	0	32	0	0	0	32	0	0	0	32	0	0
6	2	25	0	5	1	29	0	2	3	17	0	12	0	28	0	4
11	0	0	6	26	0	0	2	30	0	0	4	28	0	0	1	31
16	0	0	9	13	0	0	18	14	0	0	14	18	0	0	12	20
21	0	0	28	4	0	0	25	7	1	0	27	4	0	0	15	17

Final stress and a voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	31	1	0	0	24	8	0	0	28	4	0	0	29	3	0	0
6	29	1	2	0	26	4	2	0	29	0	3	0	32	0	0	0
11	0	0	32	0	3	0	27	2	2	0	30	0	5	0	25	2
16	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0
21	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0

TABLE 4b) TOTAL NO. RESPONSES FOR ALL CONDITIONS - SECTION 2.

Falling tone and no voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	0	14	0	0	0	14	0	0	0	14	0	0	0	14	0	0
6	2	5	0	7	0	8	0	6	0	9	0	5	0	12	0	2
11	0	0	4	10	0	0	4	10	1	0	4	9	0	0	2	12
16	0	0	8	6	0	0	5	9	0	0	6	8	0	0	4	10
21	0	0	12	2	0	0	11	3	0	0	13	1	0	0	5	9

Falling tone and a voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	12	1	1	0	8	6	0	0	11	3	0	0	10	4	0	0
6	6	0	8	0	8	1	5	0	14	0	0	0	13	0	1	0
11	0	0	14	0	0	0	13	1	0	0	12	2	0	0	12	1
16	0	0	14	0	0	0	14	0	0	0	14	0	0	0	13	1
21	0	0	13	1	0	0	14	0	0	0	14	0	0	0	14	0

TABLE 4b) Cont.

Final stress and no voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	0	14	0	0	0	14	0	0	0	14	0	0	1	13	0	0
6	2	3	0	9	1	9	0	4	1	6	1	6	0	12	0	2
11	0	0	8	6	0	0	4	10	0	0	3	11	0	0	4	10
16	0	0	11	3	0	0	9	5	0	0	6	8	0	0	4	10
21	0	0	12	2	0	0	11	3	0	0	12	2	0	0	8	6

Final stress and a voicebar:

	The CVC could be here.								The big CVC could be here.							
	Short Pause				Long Pause				Short Pause				Long Pause			
vowel	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP	CUB	CUP	COB	COP
1	13	1	0	0	10	4	0	0	10	4	0	0	8	6	0	0
6	7	1	6	0	12	0	2	0	13	0	1	0	11	3	0	0
11	0	0	14	0	0	0	14	0	0	0	13	1	2	0	12	0
16	0	0	13	1	0	0	14	0	0	0	14	0	0	0	14	0
21	0	1	13	0	0	0	14	0	0	0	14	0	0	0	14	0

TABLE 5a SECTION 1 ANALYSIS OF VARIANCE
RESPONSE INTERACTION COMPONENTS

	source		sums of squares	degrees of freedom	mean square	F-ratio
**	response	R	3212	3	1071	284
**	voice	VR	9632	3	3210	854
**	gating	GR	20295	12	1691	449
	tone	TR	29	3	9.7	2.58
*	frame	FR	63	3	21	5.53
**	pause	PR	151	3	50	13
**	VGR		9842	12	820	218
	VTR		20	3	6.8	1.8
	GTR		57	12	4.8	1.3
*	VFR		54	3	18	4.81
	GFR		44	12	3.7	1.0
	TFR		8.2	3	2.7	0.7
	VPR		31	3	10.2	2.72
**	GPR		211	12	17.6	4.68
	TPR		1.5	3	0.5	0.1
	FPR		7.5	3	2.5	0.7
	VGTR		32	12	2.7	0.7
	VGFR		63	12	5.2	1.4
	VTFR		10	3	3.4	0.9
	GTFR		69	12	5.7	1.5
*	VGPR		176	12	15	3.90
	VTPR		8.5	3	2.8	0.8
	GTPR		53	12	4.5	1.2
	VFPR		10	3	3.4	0.9
	GFPR		24	12	2.0	0.5
	TFPR		8	3	2.7	0.7
	VGTFR		32	12	2.6	0.7
	VGTPR		29	12	2.4	0.6
	VGFPR		21	12	1.8	0.5
	VTFPR		5.5	3	1.8	0.5
	GTFPR		46	12	3.8	1.0
	error-VGTFPR		45	12	3.8	-

** significant at 1% level F(3,12)=5.95 F(12,12)=4.16
* significant at 5% level F(3,12)=3.49 F(12,12)=2.69

TABLE 5b SECTION 2 ANALYSIS OF VARIANCE
RESPONSE INTERACTION COMPONENTS

	source		sums of squares	degrees of freedom	mean square	F-ratio
**	response	R	962	3	320	338
**	voice	VR	1450	3	483	510
**	gating	GR	3620	12	301	318
	tone	TR	5	3	1.7	1.8
**	frame	FR	43	3	14	15
**	pause	PR	31	3	10	11
**	VGR		1255	12	105	110
	VTR		6.6	3	2.2	2.3
	GTR		10	12	0.9	0.9
	VFR		7.9	3	2.6	2.77
**	GFR		55	12	4.6	4.88
	TFR		3.1	3	1.0	1.1
	VPR		9.8	3	3.3	3.44
**	GPR		57	12	4.7	4.99
	TPR		2.4	3	0.8	0.9
	FPR		0.6	3	0.2	0.2
	VGTR		6.5	12	0.5	0.6
**	VGFR		103	12	8.6	9
	VTFR		8.0	3	2.7	2.8
	GTFR		10	12	0.9	0.9
**	VGPR		83	12	6.9	7
	VTPR		1.4	3	0.5	0.5
	GTPR		6.9	12	0.6	0.6
	VFPR		2.3	3	0.8	0.8
	GFPR		29	12	2.4	2.57
	TFPR		2.2	3	0.7	0.8
	VGTFR		17	12	1.4	1.5
	VGTPR		5.2	12	0.4	0.5
	VGFPR		25	12	2.1	2.18
	VTFPR		4.5	3	1.5	1.6
	GTFPR		10	12	0.9	0.9
	error-VGTFPR		11	12	0.9	-

** significant at 1% level $F(3,12)=5.95$ $F(12,12)=4.16$
* significant at 5% level $F(3,12)=3.49$ $F(12,12)=2.69$

TABLE 6 REORGANIZED ANALYSIS OF VARIANCE
RESPONSE INTERACTION COMPONENTS

a) Section 1

	source	F-ratio	d.f
**	R	284	3
**	GR	449	12
**	VR	852	3
**	VGR	218	12
*	FR	6	3
	FGR	1	12
*	FVR	5	3
	FVGR	1	12
**	PR	13	3
**	PGR	5	12
	PVR	3	3
*	PVGR	4	12

b) Section 2

	source	F-ratio	d.f.
**	R	338	3
**	GR	318	12
**	VR	510	3
**	VGR	110	12
**	FR	15	3
**	FGR	5	12
	FVR	3	3
**	FVGR	9	12
**	PR	11	3
**	PGR	5	12
	PVR	3	3
**	PVGR	7	12

** significant at 1% $F(3,12)=5.95$ $F(12,12)=4.16$
* significant at 5% $F(3,12)=3.49$ $F(12,12)=2.69$

R = response
G = gating
V = voice
F = frame
P = pause

TABLE 7a) WORDS IN ISOLATION, TOTAL # RESPONSES

i) Section 1

	No Voice Bar					Voicebar				
vowel	1	6	11	16	21	1	6	11	16	21
CUB	2	0	2	1	0	31	92	11	1	1
CUP	94	32	6	1	0	1	3	0	0	0
COB	0	0	7	10	39	0	1	36	79	63
COP	0	0	65	36	25	0	1	1	0	0
TOTAL	96	32	80	48	64	32	96	48	80	64

ii) Section 2

	No Voice Bar					Voicebar				
vowel	1	6	11	16	21	1	6	11	16	21
CUB	0	0	1	0	0	10	37	5	1	0
CUP	42	13	4	0	0	4	4	0	0	0
COB	0	0	0	1	14	0	0	15	34	28
COP	0	1	30	20	14	0	1	1	0	0
TOTAL	42	14	35	21	28	14	42	21	35	28

TABLE 7b) WORDS IN ISOLATION, PERCENT RESPONSES

i) Section 1

	No Voice Bar					Voicebar				
vowel	1	6	11	16	21	1	6	11	16	21
CUB	2.1	0	2.5	2.1	0	96.9	95.8	22.9	1.25	1.6
CUP	97.9	100	7.5	2.1	0	6.25	3.1	0	0	0
COB	0	0	8.75	20.8	60.9	0	1.0	75.0	98.75	98.4
COP	0	0	81.25	75.0	39.1	0	0	2.1	0	0

ii) Section 2

	No Voice Bar					Voicebar				
vowel	1	6	11	16	21	1	6	11	16	21
CUB	0	0	2.9	0	0	71.4	88.1	23.8	2.9	0
CUP	100	92.9	11.4	0	0	28.6	9.5	0	0	0
COB	0	0	0	4.8	50	0	0	71.4	97.1	100
COP	0	7.1	85.7	95.2	50	0	2.4	4.8	0	0

List of Appendices

1. CVC's that are real English words.

    a) Arranged by consonant voicing and vowel length.
    b) Full CVC quadruplets and their frequencies.

2. ALLIGATOR programs to play randomized stimuli.

    a) Programs for sentence lists.
    b) Programs for word list.
    c) Random number lists.

3. Randomized stimuli lists.

    a) Sentence list 1.
    b) Sentence list 2.
    c) Word list.

4. Instructions to subjects and a sample response sheet.

–	–	poot	put	–	–	poof	–	–	–	–	puss	–	push	pooch	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Butch
boop	–	boot	–	–	book	–	–	booth	–	–	–	–	bush	–	–
boob	–	booed	–	–	–	–	–	–	–	booze	–	–	–	–	–
–	–	toot	–	tuke	took	–	–	tooth	–	–	–	–	–	–	–
tube	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
dupe	–	–	–	duke	–	–	–	–	–	–	–	–	–	–	–
–	–	dude	–	–	–	–	–	–	–	–	–	–	–	–	–
coop	–	coot	–	kook	cook	–	–	couth	–	–	–	–	–	–	–
–	–	cooed	could	–	–	–	–	–	–	–	–	–	–	–	–
goop	–	–	–	gook	gook?	goof	–	–	–	goose	–	–	–	–	–
–	–	–	good	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	foot	–	–	–	–	–	–	–	–	–	–	–	–
–	–	food	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
soup	–	suit	soot	–	–	–	–	sooth	–	–	–	–	–	–	–
–	–	sued	–	–	–	–	–	soothe	–	–	–	–	–	–	–
–	–	zoot	–	–	–	–	–	–	–	Zeus	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	shoot	–	–	shook	–	–	–	–	–	–	–	shoosh	–	–
–	–	shoed	–	–	–	–	–	–	–	shoes	–	–	–	–	–

Appendix lai) /u/vs./ʊ/

pape	pep	pate	pet	–	peck	–	–	–	–	pace	–	–	–
–	–	paid	ped?	–	peg	pave	–	–	–	pays	–	–	–
	–	bait	bet	bake	beck	–	–	–	–	–	Bess	–	–
babe	–	–	bed	–	–	–	BEV	bathe	–	–	–	beige	–
tape	–	Tate	tet?	take	tech?	–	–	–	–	–	Tess	–	–
–	–	–	Ted	–	–	–	–	–	–	–	–	–	–
–	–	date	debt	–	–	–	deaf	–	death	–	–	–	–
–	deb?	–	dead	–	–	Dave	–	–	–	daze	–	–	–
–	–	Kate	–	cake	keg	–	–	–	–	case	–	–	–
–	–	–	Ked	–	–	cave	–	–	–	–	–	–	–
gape	–	gate	get	–	–	–	–	–	–	–	guess	–	–
–	–	–	–	–	–	gave	GEV	–	–	gaze	–	–	–
–	–	fate	FET	fake	–	–	–	faith	–	face	fess	–	–
–	–	fade	fed	–	–	–	–	–	–	faze	fez	–	–
–	–	–	vet	–	–	–	–	–	–	vase	–	–	–
–	–	–	–	–	–	–	–	–	–	vase	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	set	sake	–	safe	–	–	Seth	–	says	–	–
–	–	–	said	–	–	save	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	zed	–	–	–	–	–	–	–	–	–	–
shape	–	–	–	shake	–	–	chef	–	–	–	–	–	–
–	–	shade	shed	–	–	shave	Chev	–	–	–	–	–	–

Appendix laii) /e/vs./ɛ/

pep	pap	pet	pat	peck	pack	–	–	–	path	–	pass	–	–
–	–	ped?	pad	peg	–	–	–	–	path?	–	–	–	–
–	–	bet	bat	beck	back	–	–	–	bath	Bess	bass	–	bash
–	–	bed	bad	–	bag	BEV	–	–	–	–	–	–	–
–	tap	tet?	tat?	tech?	tack	–	–	–	–	Tess	Tass	–	–
–	tab	Ted	tad?	–	tag	–	–	–	–	–	–	–	–
–	–	debt	–	–	–	deaf	–	death	–	–	–	–	dash
deb?	dab	dead	dad	deck	–	–	–	–	–	–	–	–	–
–	cap	–	cat	keg	–	–	calf	–	–	–	Cass	–	–
–	cab	Ked	cad	–	–	–	–	–	–	–	–	–	–
–	gap	get	–	–	–	–	gaff	–	–	guess	gas	–	gash
–	gab	–	gad	–	gag	GEV	–	–	–	–	–	–	–
–	–	FET	fat	–	–	–	–	–	–	fess	–	–	–
–	fab	fed	fad	–	–	–	–	–	–	fez	–	–	–
–	–	vet	vat	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	that	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	sap	set	sat	–	sack	–	–	Seth	–	–	sass	–	sash
–	–	said	sad	–	sag	–	salve	–	–	says	–	–	–
–	zap	–	–	–	–	–	–	–	–	–	–	–	–
–	–	zed	–	–	zag?	–	–	–	–	–	–	–	–
–	–	–	–	–	shack	chef	–	–	–	–	–	–	–
–	–	shed	shad	–	shag	–	–	–	–	–	–	–	–

Appendix laiii) /ɛ/vs./æ/

peep	pip	peat	pit	peak	pick	–	–	–	pith	piece	–	–	–
–	–	–	–	–	pig	peeve	–	–	–	peas	–	–	–
beep	–	beat	bit	beak	Bic	beef	–	–	–	–	–	–	–
–	bib	bead	bid	–	big	–	–	–	–	–	–	–	–
–	tip	teat	tit	teak	tick	–	tiff	teeth	tith	–	–	–	–
–	–	–	–	–	–	–	–	teethe	tithe	tease	–	–	–
deep	dip	–	–	deke?	Dick	–	diff?	–	–	–	–	–	dish
–	dib?	deed	did	–	dig	–	–	–	–	–	–	–	–
keep	–	–	kit	–	kick	–	–	–	kith	–	kiss	–	–
–	–	–	kid	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	geese	–	–	–
–	–	–	–	–	gig	–	–	–	–	–	–	–	–
–	–	feat	fit	–	–	fief	–	–	–	–	–	–	fish
–	–	feed	–	–	fig	–	–	–	–	–	fizz	–	–
–	VIP?	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	thick	thief	–	–	–	–	–	–	–
thebe?	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	this	–	–
–	–	–	–	–	–	–	–	–	–	these	–	–	–
seep	sip	seat	sit	seek	sick	–	–	–	–	cease	sis	–	–
–	–	seed	Sid	–	–	–	sieve	seeth	–	sieze	–	–	–
–	zip	–	zit?	Zeke	–	–	–	–	–	–	–	–	–
–	–	–	–	–	zig?	–	–	–	–	–	–	–	–
sheep	ship	sheet	–	sheik	Shick	sheaf	–	sheath	–	–	–	sheesh	–
–	–	–	–	–	–	sheave?	shive	sheathe	–	she's	–	–	–

Appendix laiv) /i/vs./I/

pope	pop	–	pot	poke	pock	–	–	–	–	–	–	–	posh
–	–	–	pod	–	–	–	–	–	–	pose	pause (paws)	–	–
–	bop?	boat	bought	–	balk	–	–	both	–	–	boss	–	–
–	–	bode	bod?	–	bog	–	–	–	–	–	–	–	–
–	top	tote	taught	toke	talk	–	–	–	–	–	toss	–	–
–	–	toad	Tod	–	tog	–	–	–	–	toes	–	–	–
dope	–	dote	–	–	dock	–	doff	–	doth	dose	–	–	–
–	daub	–	–	–	dog	dove	–	–	–	doze	–	–	–
cope	cop	coat	caught	coke	–	–	cough	–	–	–	–	–	–
–	cob	code	cod (cawed)	–	cog	cove	–	–	–	–	cauze	–	–
–	–	goat	got	–	gawk	–	–	–	–	–	–	gauche	gosh
–	gob	goad	god	–	gog?	–	–	–	–	goes	gauze	–	–
–	fop	–	fought	folk	fock	–	–	–	–	–	–	–	–
–	fob	–	–	–	fog	–	–	–	–	–	–	–	–
–	–	vote	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	vase	–	–
–	–	thoat	–	–	–	–	–	–	–	–	–	–	–
–	–	–	thawed	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	those	–	–	–
soap	sop	–	sought	coak	sock	–	–	–	–	–	sauce	–	–
–	sob	sewed	sod	–	–	–	–	–	–	sews	saws	–	–
–	–	–	zot	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	shop	–	shot	–	shock	–	–	–	–	–	–	–	–
–	–	showed	shod	–	–	–	–	–	–	shows	–	–	–

Appendix Iav) /o/vs./ɔ/

pup	pop	putt	pot	puck	pock	puff	–	–	–	pus	–	–	posh
pub	–	pud?	pod	pug	–	–	–	–	–	–	paws (pause)	–	–
–	bop?	but	bought	buck	balk	buff	–	–	–	bus	–	–	–
Bub	Bob	bud	bod?	bug	bog	–	–	–	–	buzz	–	–	–
–	top	tut?	tot	tuck	talk	tough	–	–	–	–	toss	–	–
tub	–	–	Tod	tug	tog?	–	–	–	–	–	–	–	–
–	–	–	dot	duck	dock	–	doff	–	doth	–	–	–	–
–	daub	dud	–	dug	dog	dove	–	–	–	–	–	–	–
cup	cop	cut	cot	–	cock	cuff	cough	–	–	cuss	–	–	–
cub	cob	cud	cod (cawed)	–	cog	–	–	–	–	'cuz	cause	–	–
–	–	gut	got	guck?	gawk	guff	–	–	–	Gus	–	gush	gosh
–	gob	–	god	–	gog?	–	–	–	–	–	gauze	–	–
–	fop	–	fought	–	fock	–	–	–	–	fuss	–	–	–
–	fob	–	–	–	fog	–	–	–	–	fuzz	–	–	–
–	–	–	–	–	–	–	–	–	–	–	vase	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	thought	–	–	–	–	–	–	–	–	–	–
–	–	–	–	thug	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
sup	sop	–	sought	suck	sock	–	–	–	–	–	sauce	–	–
sub	sob	–	sod	–	–	–	–	–	–	–	saws	–	–
–	–	–	zot?	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	shop	–	shot	shuck	shock	shove	–	–	–	–	–	–	–
–	–	–	shod	–	–	–	–	–	–	–	–	–	–

Appendix lavi) /ʌ/vs./ɔ/

beat	tote	teeth	goat	fate	FET	seat	face
bead	toad	teethe	goad	fade	fed	seed	faze
bit	taught	tith	got	FET	fat	sit	fess
bid	Tod	tithe	god	fed	fad	Sid	fez

bet	157	buck	35	bucks	10
bat	264	balk	2	box	1145
bed	841	bug	49	bugs	59
bad	660	bog	14	bogs	17

duck	216	cup	364	cut	1757
dock	86	cop	33	cud	7
dug	182	cub	53	caught(cot)	793(20)
dog	1380	cob	5	cawed(cod)	3(28)

coat	-	sup	4	set	3572
code	-	sop	2	sat	1138
caught(cot)	793(20)	sub	44	said	15309
cawed(cod)	3(28)	sob	15	sad	309

Appendix 1b) Full CVC quadruplets and their frequencies.
Caroll et al (1971)

MASTPP

```
C
LIB DMASUP
RUN DINP
PR &TOTAL
 UNLOAD DINP
C  INITIALIZES ALL VARIABLES
C  ESTABLISHES FILE AND RNUM
C  READ SOURCE: &TOTAL
C  DATA CNT 0
C
LABEL 1
  RUN COUNTP
   UNLOAD COUNTP
C     ADD &CNT 1
C     IF &CNT IS 10, 20, ... THEN
C     PLAYS NUMBER &CNT
C       READ SOURCE: -
C     &N(1) &N(2) &N(3) &N(4) &N(5) &N(6)
C     USES LABEL 4
C
  IF &N(1) GT 5 GOTO 2
C ELSE;
C    CONSTRUCT GATED STIMULI
    RUN DWRDNP
     UNLOAD DWRDNP
C      CREATES &CVC
    RUN DPLAYP
     UNLOAD DPLAYP
C      CREATES AND PLAYS PHRASE
    GOTO 3
C
  LABEL 2
    RUN PHROP
     UNLOAD PHROP
C      PLAYS ORIGINAL PHRASE
C
  LABEL 3
IP &CNT LT &TOTAL GOTO 1
END
```

Appendix 2ai) Master Program for Sentence Lists

DINP

```
C
C  DATA PAUSE(2)*4 + ++++
C  DATA K
DATA FILE*6
DATA RNUM*6
DATA CVC*8
DATA ONN*8
DATA PB(2)*8 P B
DATA A(5) 1 6 11 16 21
DATA N(7)
DATA DUM
DATA CNT 0
DATA TOTAL 109
PR &TOTAL &CNT
DATA WAIT(3) 1000 1000 1000
C STIMULI ORIGINAL NUMBER
DATA FRAME
DATA S(2)*4 UP DOWN
DATA DET(2)*4 + BIG
DATA WRD(4)*4 CUB CUP COB COP
STA PF
PR BE SURE NO SOU OR SINK
PR WHAT ACTIVE FILE
READ TTY: &FILE
GET &FILE
PR WHAT RNUM FILE
READ TTY: &RNUM
SOURCE &RNUM
PR PLOT
READ TTY: &N(7)
C  READ SOURCE: &TOTAL
LO CAL
PL 3
END
```

Appendix 2aii) Data Initialization Program

COUNTP

```
C
ADD &CNT 1
CL WA
LET &N(2) &CNT
DIV &N(2) 10
LET &N(3) &N(2)
MUL &N(2) 10
IF &N(2) NE &CNT GOTO 4
C  ELSE
GET D2:NUMBER
ENCODE &CVC N &CNT
LO &CVC
LO NUMBER NUMB
Q GB NUMB &CVC
PR NUMBER  &CNT
FL
WA &WAIT(3) MS
GET &FILE
LABEL 4
READ SOURCE: -
&N(1) &N(2) &N(3) &N(4) &N(5) &N(6)
END
```

DWRDNP

```
C
CL WA
LET &DUM &N(3)
ENCODE &ONN O &A(&DUM)
LO C
LO OPRUNEX4.&ONN
LET &DUM &N(4)
LO &PB(&DUM)
ENCODE &CVC C &ONN &PB(&DUM)
QUE    &CVC C &ONN &PB(&DUM)
SAVE &CVC
END
```

Appendix 2aiii) Counting Program and CVC Forming Program

DPLAYP

```
C
C  DATA K
C  DATA PAUSE(2)*4 + ++++
DATA XY*6
CL WA
IF &N(1) EQ 1 LO THE    MOD
IF &N(1) EQ 2 LO THEBIG MOD
LO &CVC
IF &N(5) EQ 1 LO SHORTSIL   SIL
IF &N(5) EQ 2 LO LONGSIL    SIL
LO COULD VERB
IF &N(2) EQ 1 LO BEHEREUP  HERE
IF &N(2) EQ 2 LO BEHEREDN  HERE
QUE GB MOD &CVC SIL VERB HERE
PLAY
ERASE &CVC
C  LET &K &N(5)
ENCODE  &XY &CVC +
IF &N(5) EQ 2 ENCODE &XY &CVC ++++
LET &FRAME &N(1)
LET &DUM   &N(2)
PR THE &DET(&FRAME) &XY COULD BE -
  HERE &S(&DUM)
WAIT &WAIT(1) MS
END
```

PHROP

```
GET ORIPHR
ENCODE &CVC A &N(3) &N(2)
CL WA
LO &CVC
PLAY
WAIT &WAIT(3) MS
LET &DUM &N(2)
LET &FRAME &N(3)
PR THE &DET(&FRAME) &WRD(&DUM) -
  COULD BE HERE
GET &FILE
```

Appendix 2aiv) Phrase Playing Programs

DIRECTORY DMASUP FULL

DO: DMASUP.WO BFD 11/16/77
SIZE: 20 BLOCKS LOC: 650 CREATED: 11/16/17

NAME	FREQ	SBLK	EP	EB	XP	XB
MASTPP	16	651	0	0	151	0
DWRDNP	16	655	0	0	160	0
COUNTP	16	654	0	0	248	0
PHROP	16	658	0	0	142	0
DINP	16	652	0	0	87	1
DPLAYP	16	656	0	0	107	1

DIRECTORY BFDMSC FULL

DO: BFDMSC.WI BFD 11/16/77
SIZE: 400 BLOCKS LOC: 1496 CREATED: 11/16/77

NAME	FREQ	SBLK	EP	EB	XP	XB
OPRUNEX4	16	1504	0	0	199	13
		021	0	0	13	12
		016	0	0	46	9
		011	0	0	80	6
		06	0	0	114	3
		01	0	0	143	0
BORIG	16	1518	0	0	240	8
		BB	43	1	224	5
		VBAR	140	2	224	5
		VOW	44	1	140	2
B	16	1527	0	0	181	4
P	16	1532	0	0	181	4
C	16	1547	0	0	111	5
THE	16	1578	0	0	191	5
BEHEREDN	16	1629	0	0	73	25
CAL	16	1679	0	0	214	12
BEHEREUP	16	1715	0	0	61	26
SHORTSIL	16	1497	0	0	2	4
LONGSIL	16	1537	0	0	247	7
CO21B	16	1598	0	0	51	22
THEBIG	16	1553	0	0	71	24
COULD	16	1584	0	0	114	12

Appendix 2av) Program Directory and Acoustic Segment Directory

DIRECTORY ORIPHR FULL

DO: ORIPHR.WI BFD 11/16/77
SIZE: 600 BLOCKS LOC: 2299 CREATED: 11/16/17

NAME	FREQ	SBLK	EP	EB	XP	XB
A11	16	2300	0	0	194	67
A12	16	2368	0	0	7	68
A13	16	2437	0	0	133	70
A14	16	2508	0	0	73	75
A21	16	2574	0	0	223	78
A22	16	2653	0	0	246	80
A23	16	2734	0	0	19	82
A24	16	2817	0	0	75	81

DIRECTORY D2:NUMBER FULL

D2: NUMBER.WI BFD 11/16/77
SIZE: 400 BLOCKS LOC: 3664 CREATED: 11/16/77

NAME	FREQ	SBLK	EP	EB	XP	XB
N20	16	3665	0	0	101	24
NUMBER	16	3690	0	0	243	19
N10	16	3710	0	0	126	22
N30	16	3733	0	0	198	30
N40	16	3764	0	0	63	31
N50	16	3796	0	0	255	28
N60	16	3825	0	0	255	32
N70	16	3858	0	0	63	36
N80	16	3895	0	0	223	22
N90	16	3918	0	0	255	26
N100	16	3945	0	0	140	29
N110	16	3975	0	0	151	57

SIZE	LOC	FIELD
31	4033	0

31 FREE BLOCKS

Appendix 2avi) Original Phrases Directory and Numbers Directory

```
    DEXWRP

C
LIB DMASUP
RUN DINP

 UNLOAD DINP
C
LET &TOTAL 61
C WORD LIST IS SHORTER
C
C  INITIALIZES ALL VARIABLES
C  ESTABLISHES FILE AND RNUM
C  READ SOURCE: &TOTAL
C  DATA CNT 0
C
LABEL 1
  RUN COUNTP
   UNLOAD COUNTP
C    ADD &CNT 1
C    IF &CNT IS 10, 20, ... THEN
C    PLAYS NUMBER &CNT
C      READ SOURCE: -
C    &N(1) &N(2) &N(3) &N(4) &N(5) &N(6)
C    USES LABEL 4
C
  IF &N(1) GT 5 GOTO 2
C ELSE;
C   CONSTRUCT GATED STIMULI
    RUN DWRDNP
     UNLOAD DWRDNP
C     CREATES &CVC
C
    ERASE &CVC
    GOTO 3
C
  LABEL 2
    RUN CVCOP
      UNLOAD CVCOP
C
  LABEL 3
  PLAY
  WAIT &WAIT(1) MS
  PR &CVC
IF &CNT LT &TOTAL GOTO 1
```

Appendix 2b i) Master Program for Word Lists

CVCOP

```
C
GET CVCORI
LET &DUM &N(2)
ENCODE &CVC &WRD(&DUM)
LO &CVC
GET &FILE
END
```

DO: CVCORI.WI BFD 11/16/77
SIZE: 250 BLOCKS LOC: 352 CREATED: 11/2/77

NAME	FREQ	SBLK	EP	EB	XP	XB
CUPO	16	353	0	0	145	20
COBO	16	374	0	0	238	24
CUBO	16	399	0	0	255	21
COPO	16	421	0	0	99	16
CUB	16	438	0	0	135	14
CUP	16	453	0	0	207	12
COB	16	466	0	0	18	18
COPA14	16	485	0	0	212	16
COP	16	502	0	0	34	15

DIRECTORY DMASUP FULL

DO: DMASUP.WO BFD 11/16/77
SIZE: 11 BLOCKS LOC: 740 CREATED: 11/16/77

NAME	FREQ	SBLK	EP	EB	XP	XB
DWRDNP	16	742	0	0	160	0
COUNTP	16	743	0	0	248	0
PHROP	16	744	0	0	142	0
DINP	16	745	0	0	87	1
DPLAYP	16	747	0	0	107	1
CVCOP	16	750	0	0	67	0
MASTPP	16	741	0	0	161	0
DEXWRP	16	749	0	0	183	0

Appendix 2b ii) Original CVC Playing Program,
Original CVC Directory, Program Directory

LIST RANDM1

1	10	4	2	0	0	1
2	10	3	1	0	0	2
3	10	1	1	0	0	3
4	10	2	2	0	0	4
5	10	1	2	0	0	5
6	10	2	1	0	0	6
7	10	3	2	0	0	7
8	10	4	1	0	0	8
9	2	1	2	2	2	1
10	1	2	5	1	1	2
11	2	2	1	1	2	3
12	1	1	4	2	1	4
13	1	1	3	2	1	5
14	10	3	2	0	0	9
15	2	2	5	1	2	1
16	1	1	1	2	1	2
17	1	2	2	2	2	3
18	2	1	3	1	1	4
19	2	2	4	2	1	5
20	10	4	1	0	0	10
21	1	1	1	1	2	6
22	2	1	5	1	1	7
23	1	2	2	2	1	8
24	1	2	4	2	2	9
25	2	1	3	1	2	10
26	10	1	2	0	0	11
27	2	1	5	2	1	11
28	1	2	1	1	1	12
29	2	2	3	1	2	13
30	1	1	2	2	1	14
31	2	1	4	2	2	15
32	10	2	1	0	0	12
33	1	2	5	1	2	16
34	1	2	4	1	1	17
35	2	1	1	2	1	18
36	1	1	2	2	2	19
37	2	2	3	1	1	20
38	10	4	2	0	0	13
39	1	1	3	2	2	21
40	2	2	2	1	1	22
41	2	2	5	2	2	23
42	1	1	1	1	1	24
43	2	2	4	2	2	25
44	10	2	2	0	0	14
45	1	1	3	1	2	26
46	1	1	5	1	1	27
47	2	2	4	1	1	28
48	2	1	2	2	2	29
49	1	2	1	1	2	30
50	10	3	1	0	0	15
51	1	1	2	1	1	31
52	2	2	5	2	1	32
53	2	1	1	1	2	33
54	1	2	4	2	1	34
55	1	2	3	2	2	35
56	10	1	1	0	0	16
57	2	1	3	2	1	36
58	1	1	4	1	2	37
59	2	2	1	1	2	38
60	1	1	5	2	1	39
61	2	2	2	2	2	40
62	10	1	2	0	0	17
63	2	2	2	1	2	41
64	1	1	3	2	1	42
65	1	1	4	1	1	43
66	2	2	1	2	2	44
67	2	2	5	1	1	45
68	10	2	2	0	0	18
69	1	1	1	2	2	46
70	1	2	4	1	2	47
71	2	1	3	2	2	48
72	1	1	2	1	2	49
73	2	2	1	1	1	50
74	10	4	1	0	0	19
75	1	2	5	2	2	51
76	2	1	2	1	1	52
77	1	1	4	2	2	53
78	2	2	1	2	1	54
79	2	2	3	2	2	55
80	10	3	1	0	0	20
81	1	1	5	1	2	56
82	1	1	3	1	1	57
83	2	2	4	1	2	58
84	1	1	4	2	1	59
85	2	2	2	2	1	60
86	10	2	1	0	0	21
87	1	1	5	2	2	61
88	2	2	3	2	1	62
89	1	2	1	2	2	63
90	2	1	1	1	1	64
91	2	1	4	2	1	65
92	10	3	2	0	0	22
93	1	2	3	1	2	66
94	1	2	2	1	1	67

APPENDIX 2ci) Random Number List One

LIST RANDM1

95	2	1	5	2	2	68
96	1	2	3	2	1	69
97	2	1	2	1	2	70
98	10	1	1	0	0	23
99	2	1	1	2	2	71
100	1	2	5	1	1	72
101	1	2	3	1	1	73
102	2	1	4	1	2	74
103	2	1	5	1	2	75
104	10	4	2	0	0	24
105	1	2	2	1	2	76
106	1	2	5	2	1	77
107	2	1	4	1	1	78
108	2	1	2	2	1	79
109	1	2	1	2	1	80

END OF FILE

APPENDIX 2ci) Cont

LIST RANDM2

1	10	4	2	0	0	1
2	10	3	1	0	0	2
3	10	1	1	0	0	3
4	10	2	2	0	0	4
5	10	1	2	0	0	5
6	10	2	1	0	0	6
7	10	3	2	0	0	7
8	10	4	1	0	0	8
9	2	2	5	1	2	1
10	1	1	1	2	1	2
11	1	2	2	2	2	3
12	2	1	3	1	1	4
13	2	2	4	2	1	5
14	10	3	2	0	0	9
15	2	1	2	2	2	1
16	1	2	5	1	1	2
17	2	2	1	1	2	3
18	1	1	4	2	1	4
19	1	1	3	2	1	5
20	10	4	1	0	0	10
21	2	2	4	1	2	6
22	1	2	3	2	2	7
23	2	1	1	1	1	8
24	2	2	2	1	1	9
25	1	1	5	2	2	10
26	10	1	2	0	0	11
27	2	2	5	1	2	11
28	1	1	1	2	1	12
29	2	2	4	2	2	13
30	1	1	2	1	1	14
31	2	1	3	2	2	15
32	10	2	1	0	0	12
33	1	2	3	1	1	16
34	1	2	4	1	2	17
35	2	1	1	2	1	18
36	1	2	5	1	2	19
37	2	1	2	2	1	20
38	10	4	2	0	0	13
39	1	2	5	2	1	21
40	2	1	3	1	2	22
41	1	1	1	1	2	23
42	2	2	4	2	1	24
43	2	2	2	1	2	25
44	10	2	2	0	0	14
45	1	1	3	2	2	26
46	1	2	5	2	2	27
47	2	1	2	1	1	28
48	2	2	1	2	1	29
49	1	1	4	1	2	30
50	10	3	1	0	0	15
51	1	1	5	1	1	31
52	2	2	4	1	1	32
53	2	2	2	2	2	33
54	1	1	1	1	1	34
55	2	1	3	2	1	35
56	10	1	1	0	0	16
57	1	2	1	2	2	36
58	2	2	3	1	2	37
59	1	1	5	1	2	38
60	2	1	2	1	2	39
61	1	2	4	2	1	40
62	10	1	2	0	0	17
63	1	1	3	1	2	41
64	2	2	5	2	1	42
65	2	1	1	1	2	43
66	1	2	4	2	2	44
67	1	2	2	2	1	45
68	10	2	2	0	0	18
69	2	1	3	1	1	46
70	2	1	1	2	2	47
71	1	2	3	1	2	48
72	2	1	5	2	1	49
73	1	2	4	1	1	50
74	10	4	1	0	0	19
75	1	2	2	2	2	51
76	2	1	4	1	2	52
77	1	1	1	2	2	53
78	2	2	2	2	1	54
79	1	2	1	1	1	55
80	10	3	1	0	0	20
81	2	1	5	1	2	56
82	1	2	3	2	1	57
83	2	1	5	1	1	58
84	1	1	4	2	2	59
85	2	2	1	1	1	60
86	10	2	1	0	0	21
87	1	1	3	1	1	61
88	2	2	1	2	2	62
89	1	1	2	2	1	63
90	2	2	3	1	1	64
91	1	1	5	2	1	65
92	10	3	2	0	0	22
93	2	2	3	2	2	66
94	2	2	3	2	1	67

APPENDIX 2cii) Random Number List Two

95	1	1	2	1	2	68	103	2	1	5	2	2	75
96	1	2	1	1	2	69	104	10	4	2	0	0	24
97	2	1	4	2	1	70	105	1	2	2	1	1	76
98	10	1	1	0	0	23	106	2	2	5	1	2	77
99	2	2	5	2	2	71	107	1	1	4	1	1	78
100	1	1	2	2	2	72	108	1	2	2	1	2	79
101	2	1	4	1	1	73	109	2	1	4	2	2	80
102	1	2	1	2	1	74	END OF FILE						

APPENDIX 2cii) Cont.

```
:LIBRARY DMASUP
DONE.
:R MASTPP
 109    0
ACTIVE:  DO:BFDMSC.WI
LIBRARY. DO:DMASUP.WO

BE SURE NO SOU  OR SINK
WHAT ACTIVE FILE
?BFDMSC
WHAT RNUM FILE
?RANDM1
PLOT
?0
 109
THE  BIG  COP  COULD  BE HERE
THE  +    COB  COULD  BE HERE
THE  +    CUB  COULD  BE HERE
THE  BIG  CUP  COULD  BE HERE
THE  BIG  CUB  COULD  BE HERE
THE  +    CUP  COULD  BE HERE
THE  BIG  COB  COULD  BE HERE
THE  +    COP  COULD  BE HERE
THE  BIG  CO6B++ COULD  BE HERE UP
NUMBER   10
THE  +    CO21P+ COULD  BE HERE DOWN
THE  BIG  CO1P++ COULD  BE HERE DOWN
THE  +    CO16B+ COULD  BE HERE UP
THE  +    CO11B+ COULD  BE HERE UP
THE  BIG  COB  COULD  BE HERE
THE  BIG  CO21P+ COULD  BE HERE DOWN
THE  +    CO1B+  COULD  BE HERE UP
THE  +    CO6B++ COULD  BE HERE DOWN
THE  BIG  CO11P+ COULD  BE HERE UP
THE  BIG  CO16B+ COULD  BE HERE DOWN
NUMBER   20
THE  +    COP  COULD  BE HERE
THE  +    CO1P++ COULD  BE HERE UP
THE  BIG  CO21P+ COULD  BE HERE UP
THE  +    CO6B+  COULD  BE HERE DOWN
THE  +    CO16B+ COULD  BE HERE DOWN
THE  BIG  CO11P+ COULD  BE HERE UP
THE  BIG  CUB  COULD  BE HERE
THE  BIG  CO21B+ COULD  BE HERE UP
THE  +    CO1P+  COULD  BE HERE DOWN
THE  BIG  CO11P+ COULD  BE HERE DOWN
NUMBER   30
THE  +    CO6B+  COULD  BE HERE UP
THE  BIG  CO16B+ COULD  BE HERE UP
THE  +    CUP  COULD  BE HERE
THE  +    CO21P+ COULD  BE HERE DOWN
THE  +    CO16P+ COULD  BE HERE DOWN
THE  BIG  CO1B+  COULD  BE HERE UP
```

Appendix 3a) Sentence List One

THE + CO6B++ COULD BE HERE UP
THE BIG CO11P+ COULD BE HERE DOWN
THE BIG COP COULD BE HERE
THE + CO11B+ COULD BE HERE UP
NUMBER 40
THE BIG CO6P+ COULD BE HERE DOWN
THE BIG CO21B+ COULD BE HERE DOWN
THE + CO1P+ COULD BE HERE UP
THE BIG CO16B+ COULD BE HERE DOWN
THE BIG CUP COULD BE HERE
THE + CO11P+ COULD BE HERE UP
THE + CO21P+ COULD BE HERE UP
THE BIG CO16P+ COULD BE HERE DOWN
THE BIG CO6B++ COULD BE HERE UP
THE + CO1P++ COULD BE HERE DOWN
NUMBER 50
THE + COB COULD BE HERE
THE + CO6P+ COULD BE HERE UP
THE BIG CO21B+ COULD BE HERE DOWN
THE BIG CO1P++ COULD BE HERE UP
THE + CO16B+ COULD BE HERE DOWN
THE + CO11B+ COULD BE HERE DOWN
THE + CUB COULD BE HERE
THE BIG CO11B+ COULD BE HERE UP
THE + CO16P+ COULD BE HERE UP
THE BIG CO1P++ COULD BE HERE DOWN
NUMBER 60
THE + CO21B+ COULD BE HERE UP
THE BIG CO6B++ COULD BE HERE DOWN
THE BIG CUB COULD BE HERE
THE BIG CO6P++ COULD BE HERE DOWN
THE + CO11B+ COULD BE HERE UP
THE + CO16P+ COULD BE HERE UP
THE BIG CO1B++ COULD BE HERE DOWN
THE BIG CO21P+ COULD BE HERE DOWN
THE BIG CUP COULD BE HERE
THE + CO1B++ COULD BE HERE UP
NUMBER 70
THE + CO16P+ COULD BE HERE DOWN
THE BIG CO11B+ COULD BE HERE UP
THE + CO6P++ COULD BE HERE UP
THE BIG CO1P+ COULD BE HERE DOWM
THE + COP COULD BE HERE
THE + CO21B+ COULD BE HERE DOWN
THE BIG CO6P+ COULD BE HERE UP
THE + CO16B+ COULD BE HERE UP
THE BIG CO1B+ COULD BE HERE DOWN
THE BIG CO11B+ COULD BE HERE DOWN
NUMBER 80
THE + COB COULD BE HERE
THE + CO21P+ COULD BE HERE UP
THE + CO11P+ COULD BE HERE UP
THE BIG CO16P+ COULD BE HERE DOWN

Appendix 3a) Cont'd

```
THE  +    CO16B+ COULD  BE HERE UP
THE  BIG  CO6B+  COULD  BE HERE DOWN
THE  +    CUP  COULD  BE HERE
THE  +    CO21B+ COULD  BE HERE UP
THE  BIG  CO11B+ COULD  BE HERE DOWN
THE  +    CO1B++ COULD  BE HERE DOWN
NUMBER   90
THE  BIG  CO1P+  COULD  BE HERE UP
THE  BIG  CO16B+ COULD  BE HERE UP
THE  BIG  COB  COULD  BE HERE
THE  +    CO11P+ COULD  BE HERE DOWN
THE  +    CO61P+ COULD  BE HERE DOWN
THE  BIG  CO21B+ COULD  BE HERE UP
THE  +    CO11B+ COULD  BE HERE DOWN
THE  BIG  CO6P++ COULD  BE HERE UP
THE  +    CUB  COULD  BE HERE
THE  BIG  CO1B++ COULD  BE HERE UP
NUMBER  100
THE  +    CO21P+ COULD  BE HERE DOWN
THE  +    CO11P+ COULD  BE HERE DOWN
THE  BIG  CO16P+ COULD  BE HERE UP
THE  BIG  CO21P+ COULD  BE HERE UP
THE  BIG  COP  COULD  BE HERE
THE  +    CO6P++ COULD  BE HERE DOWN
THE  +    CO21B+ COULD  BE HERE DOWN
THE  BIG  CO16P+ COULD  BE HERE UP
THE  BIG  CO6B+  COULD  BE HERE UP
THE  +    CO1B+  COULD  BE HERE DOWN
```

Appendix 3a) Cont'd

```
:LIBRARY DMASUP
DONE.
:RUN MASTPP
 109    0
LIBRARY: DO:DMASUP.WO

BE SURE NO SOU  OR SINK
WHAT ACTIVE FILE
?BFDMSC
WHAT RNUM FILE
?RANDM2
PLOT
?0
 109
THE  BIG  COP   COULD  BE HERE
THE  +    COB   COULD  BE HERE
THE  +    CUB   COULD  BE HERE
THE  BIG  CUP   COULD  BE HERE
THE  BIG  CUB   COULD  BE HERE
THE  +    CUP   COULD  BE HERE
THE  BIG  COB   COULD  BE HERE
THE  +    COP   COULD  BE HERE
THE  BIG  CO21P+ COULD  BE HERE DOWN
NUMBER   10
THE  +    CO1B+  COULD  BE HERE UP
THE  +    CO6B++ COULD  BE HERE DOWN
THE  BIG  CO11P+ COULD  BE HERE UP
THE  BIG  CO16B+ COULD  BE HERE DOWN
THE  BIG  COB   COULD  BE HERE
THE  BIG  CO6B++ COULD  BE HERE UP
THE  +    CO21P+ COULD  BE HERE DOWN
THE  BIG  CO1P++ COULD  BE HERE DOWN
THE  +    CO16B+ COULD  BE HERE UP
THE  +    CO11B+ COULD  BE HERE UP
NUMBER   20
THE  +    COP   COULD  BE HERE
THE  BIG  CO16P+ COULD  BE HERE DOWN
THE  +    CO11B+ COULD  BE HERE DOWN
THE  BIG  CO1P+  COULD  BE HERE UP
THE  BIG  CO6P+  COULD  BE HERE DOWN
THE  +    CO21B+ COULD  BE HERE UP
THE  BIG  CUB   COULD  BE HERE
THE  BIG  CO21P+ COULD  BE HERE DOWN
THE  +    CO1B+  COULD  BE HERE UP
THE  BIG  CO16B+ COULD  BE HERE DOWN
NUMBER   30
THE  +    CO6P+  COULD  BE HERE UP
THE  BIG  CO11B+ COULD  BE HERE UP
THE  +    CUP   COULD  BE HERE
THE  +    CO11P+ COULD  BE HERE DOWN
THE  +    CO16P+ COULD  BE HERE DOWN
THE  BIG  CO1B+  COULD  BE HERE UP
```

Appendix 3b) Sentence List Two

```
THE  +    CO21P+ COULD  BE HERE DOWN
THE  BIG  CO6B+  COULD  BE HERE UP
THE  BIG  COP  COULD  BE HERE
THE  +    CO21B+ COULD  BE HERE DOWN
NUMBER   40
THE  BIG  CO11P+ COULD  BE HERE UP
THE  +    CO1P++ COULD  BE HERE UP
THE  BIG  CO16B+ COULD  BE HERE DOWN
THE  BIG  CO6P++ COULD  BE HERE DOWN
THE  BIG  CUP  COULD  BE HERE
THE  +    CO11B+ COULD  BE HERE UP
THE  +    CO21B+ COULD  BE HERE DOWN
THE  BIG  CO6P+  COULD  BE HERE UP
THE  BIG  CO1B+  COULD  BE HERE DOWN
THE  +    CO16P+ COULD  BE HERE UP
NUMBER   50
THE  +    COB  COULD  BE HERE
THE  +    CO21P+ COULD  BE HERE UP
THE  BIG  CO16P+ COULD  BE HERE DOWN
THE  BIG  CO6B++ COULD  BE HERE DOWN
THE  +    CO1P+  COULD  BE HERE UP
THE  BIG  CO11B+ COULD  BE HERE UP
THE  +    CUB  COULD  BE HERE
THE  +    CO1B++ COULD  BE HERE DOWN
THE  BIG  CO11P+ COULD  BE HERE DOWN
THE  +    CO21P+ COULD  BE HERE UP
NUMBER   60
THE  BIG  CO6P++ COULD  BE HERE UP
THE  +    CO16B+ COULD  BE HERE DOWN
THE  BIG  CUB  COULD  BE HERE
THE  +    CO11P+ COULD  BE HERE UP
THE  BIG  CO21B+ COULD  BE HERE DOWN
THE  BIG  CO1P++ COULD  BE HERE UP
THE  +    CO16B+ COULD  BE HERE DOWN
THE  +    CO6B+  COULD  BE HERE DOWN
THE  BIG  CUP  COULD  BE HERE
THE  BIG  CO11P+ COULD  BE HERE UP
NUMBER   70
THE  BIG  CO1B++ COULD  BE HERE UP
THE  +    CO11P+ COULD  BE HERE DOWN
THE  BIG  CO21B+ COULD  BE HERE UP
THE  +    CO16P+ COULD  BE HERE DOWM
THE  +    COP  COULD  BE HERE
THE  +    CO6B++ COULD  BE HERE DOWN
THE  BIG  CO16P+ COULD  BE HERE UP
THE  +    CO1B++ COULD  BE HERE UP
THE  BIG  CO6B+  COULD  BE HERE DOWN
THE  +    CO1P+  COULD  BE HERE DOWN
NUMBER   80
THE  +    COB  COULD  BE HERE
THE  BIG  CO21P+ COULD  BE HERE UP
THE  +    CO11B+ COULD  BE HERE DOWN
THE  BIG  CO21P+ COULD  BE HERE UP
```

Appendix 3b) Cont'd

```
THE  +    CO16B+ COULD  BE HERE UP
THE  BIG  CO1P+  COULD  BE HERE DOWN
THE  +    CUP  COULD  BE HERE
THE  +    CO11P+ COULD  BE HERE UP
THE  BIG  CO1B++ COULD  BE HERE DOWN
THE  +    CO6B+  COULD  BE HERE UP
NUMBER   90
THE  BIG  CO11P+ COULD  BE HERE DOWN
THE  +    CO21B+ COULD  BE HERE UP
THE  BIG  COB  COULD  BE HERE
THE  BIG  CO11B+ COULD  BE HERE DOWN

THE  BIG  CO11B+ COULD  BE HERE DOWN
THE  +    CO6P++ COULD  BE HERE UP
THE  +    CO1P++ COULD  BE HERE DOWN
THE  BIG  CO16B+ COULD  BE HERE UP
THE  +    CUB  COULD  BE HERE
THE  BIG  CO21B+ COULD  BE HERE DOWN
NUMBER  100
THE  +    CO6B++ COULD  BE HERE UP
THE  BIG  CO16P+ COULD  BE HERE UP
THE  +    CO1B+  COULD  BE HERE DOWN
THE  BIG  CO21B+ COULD  BE HERE UP
THE  BIG  COP  COULD  BE HERE
THE  +    CO6P++ COULD  BE HERE DOWN
THE  BIG  CO21P+ COULD  BE HERE DOWN
THE  +    CO16P+ COULD  BE HERE UP
THE  +    CO6P++ COULD  BE HERE DOWN
THE  BIG  CO16B+ COULD  BE HERE UP
```

Appendix 3b) Cont'd

```
:LIBRARY DMASUP
DONE.
:RUN DEXWRP
WHAT TOTAL
?61
WHAT RNUM FILE
?RANDM1
PLOT
?0
COP
COB
CUB
CUP
CUB
CUP
COB
COP
CO6B
NUMBER   10
CO21P
CO1P
CO16B
CO11B
COB
CO21P
CO1B
CO6B
CO11P
CO16B
NUMBER   20
COP
CO1P
CO21P
CO6B
CO16P
CO11P
CUB
CO21B
CO1P
CO11P
NUMBER   30
CO6B
CO16B
CUP
CO21P
CO16P
CO1B
CO6B
CO11P
COP
CO11B
NUMBER   40
CO6P
CO21B
CO1P
CO16B
CUP
CO11P
CO21P
CO26P
CO6B
CO1P
NUMBER   50
COB
CO6P
CO21B
CO1P
CO16B
CO11B
CUB
CO11B
CO16P
CO1P
NUMBER   60
CO21B
CO6B
```

Appendix 3c) Word List

The study which you have been asked to participate in concerns the perception of speech. Through your headphones you will listen to a list of 109 phrases. To help you keep your place on the response sheet every tenth phrase is preceded by its number. Each phrase contains one of the four words, "cub, cup, cob, cop". Your task is to decide which word is in each phrase and circle that word on the response sheet. If you are not sure which word you heard make a guess and don't fall behind.

Appendix 4a) Instructions for Sentence Lists

The study which you have been asked to participate in concerns the perception of speech. Through your headphones you will listen to a list of 61 words. To help you keep your place on the response sheet every tenth word is preceded by its number. Your task is to decide which of the four words, "cub, cup, cob, cop" you heard and circle that word on the response sheet. If you are not sure which word you heard make a guess and don't fall behind.

Appendix 4b) Instructions for Word Lists

					30	CUB	CUP	COB	COP	60	CUB	CUP	COB	COP	90	CUB	CUP	COB	COP
1	CUB	CUP	COB	COP	31	CUB	CUP	COB	COP	61	CUB	CUP	COB	COP	91	CUB	CUP	COB	COP
2	CUB	CUP	COB	COP	32	CUB	CUP	COB	COP	62	CUB	CUP	COB	COP	92	CUB	CUP	COB	COP
3	CUB	CUP	COB	COP	33	CUB	CUP	COB	COP	63	CUB	CUP	COB	COP	93	CUB	CUP	COB	COP
4	CUB	CUP	COB	COP	34	CUB	CUP	COB	COP	64	CUB	CUP	COB	COP	94	CUB	CUP	COB	COP
5	CUB	CUP	COB	COP	35	CUB	CUP	COB	COP	65	CUB	CUP	COB	COP	95	CUB	CUP	COB	COP
6	CUB	CUP	COB	COP	36	CUB	CUP	COB	COP	66	CUB	CUP	COB	COP	96	CUB	CUP	COB	COP
7	CUB	CUP	COB	COP	37	CUB	CUP	COB	COP	67	CUB	CUP	COB	COP	97	CUB	CUP	COB	COP
8	CUB	CUP	COB	COP	38	CUB	CUP	COB	COP	68	CUB	CUP	COB	COP	98	CUB	CUP	COB	COP
9	CUB	CUP	COB	COP	39	CUB	CUP	COB	COP	69	CUB	CUP	COB	COP	99	CUB	CUP	COB	COP
10	CUB	CUP	COB	COP	40	CUB	CUP	COB	COP	70	CUB	CUP	COB	COP	100	CUB	CUP	COB	COP
11	CUB	CUP	COB	COP	41	CUB	CUP	COB	COP	71	CUB	CUP	COB	COP	101	CUB	CUP	COB	COP
12	CUB	CUP	COB	COP	42	CUB	CUP	COB	COP	72	CUB	CUP	COB	COP	102	CUB	CUP	COB	COP
13	CUB	CUP	COB	COP	43	CUB	CUP	COB	COP	73	CUB	CUP	COB	COP	103	CUB	CUP	COB	COP
14	CUB	CUP	COB	COP	44	CUB	CUP	COB	COP	74	CUB	CUP	COB	COP	104	CUB	CUP	COB	COP
15	CUB	CUP	COB	COP	45	CUB	CUP	COB	COP	75	CUB	CUP	COB	COP	105	CUB	CUP	COB	COP
16	CUB	CUP	COB	COP	46	CUB	CUP	COB	COP	76	CUB	CUP	COB	COP	106	CUB	CUP	COB	COP
17	CUB	CUP	COB	COP	47	CUB	CUP	COB	COP	77	CUB	CUP	COB	COP	107	CUB	CUP	COB	COP
18	CUB	CUP	COB	COP	48	CUB	CUP	COB	COP	78	CUB	CUP	COB	COP	108	CUB	CUP	COB	COP
19	CUB	CUP	COB	COP	49	CUB	CUP	COB	COP	79	CUB	CUP	COB	COP	109	CUB	CUP	COB	COP
20	CUB	CUP	COB	COP	50	CUB	CUP	COB	COP	80	CUB	CUP	COB	COP	110	CUB	CUP	COB	COP
21	CUB	CUP	COB	COP	51	CUB	CUP	COB	COP	81	CUB	CUP	COB	COP	111	CUB	CUP	COB	COP
22	CUB	CUP	COB	COP	52	CUB	CUP	COB	COP	82	CUB	CUP	COB	COP	112	CUB	CUP	COB	COP
23	CUB	CUP	COB	COP	53	CUB	CUP	COB	COP	83	CUB	CUP	COB	COP	113	CUB	CUP	COB	COP
24	CUB	CUP	COB	COP	54	CUB	CUP	COB	COP	84	CUB	CUP	COB	COP	114	CUB	CUP	COB	COP
25	CUB	CUP	COB	COP	55	CUB	CUP	COB	COP	85	CUB	CUP	COB	COP	115	CUB	CUP	COB	COP
26	CUB	CUP	COB	COP	56	CUB	CUP	COB	COP	86	CUB	CUP	COB	COP	116	CUB	CUP	COB	COP
27	CUB	CUP	COB	COP	57	CUB	CUP	COB	COP	87	CUB	CUP	COB	COP	117	CUB	CUP	COB	COP
28	CUB	CUP	COB	COP	58	CUB	CUP	COB	COP	88	CUB	CUP	COB	COP	118	CUB	CUP	COB	COP
29	CUB	CUP	COB	COP	59	CUB	CUP	COB	COP	89	CUB	CUP	COB	COP	119	CUB	CUP	COB	COP

Appendix 4c) Response Sheet

List of Figures

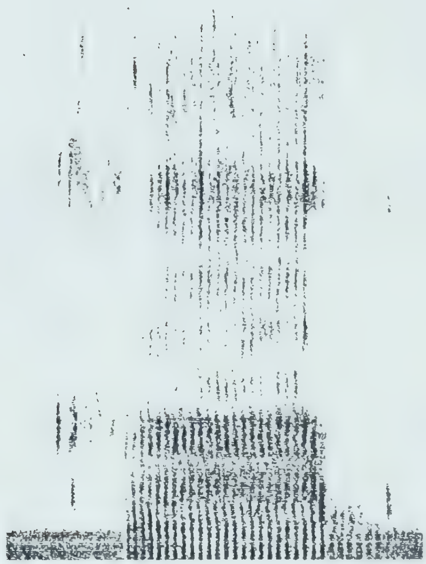
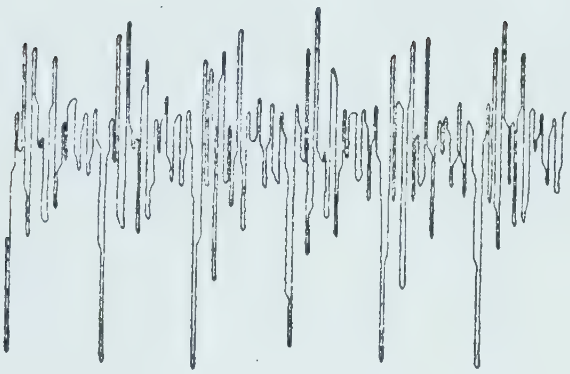


Fig. 1 Spectrogram of "cob".

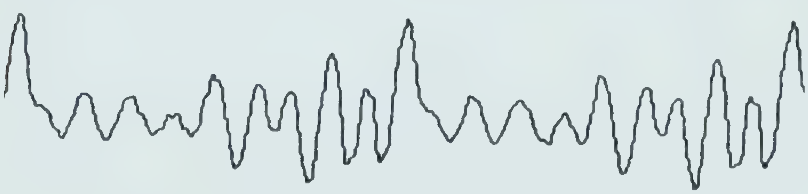
a) Segment C.



b) Segment OPRUNE.

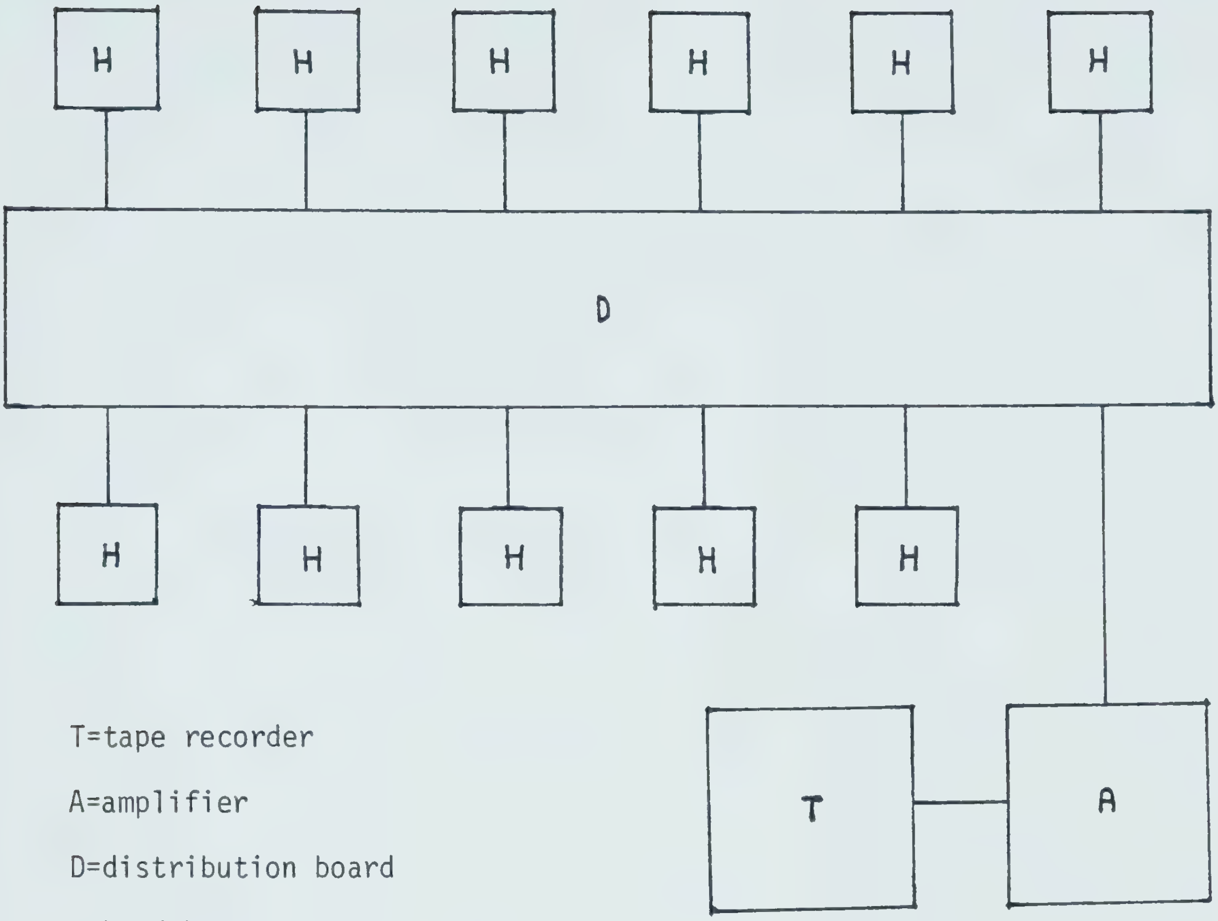
c) Initial part of Segment B.

d) Final part of Segment B - the amplified voicebar.



e) Two vowel pulses on an expanded time scale.

Fig. 2) Oscillograms of acoustic segments



T=tape recorder

A=amplifier

D=distribution board

H=headphones

Amplifier settings

	Section 1	Section 2
bass	-6	0
treble	-8	0
balance	0	0
volume	3	3
function	phono	tapel-source
hi filter	on	
mode	mono	

Tape recorder set to read 0 VU for the 500 Hz calibration tone.

Fig. 3 Playback Setup.

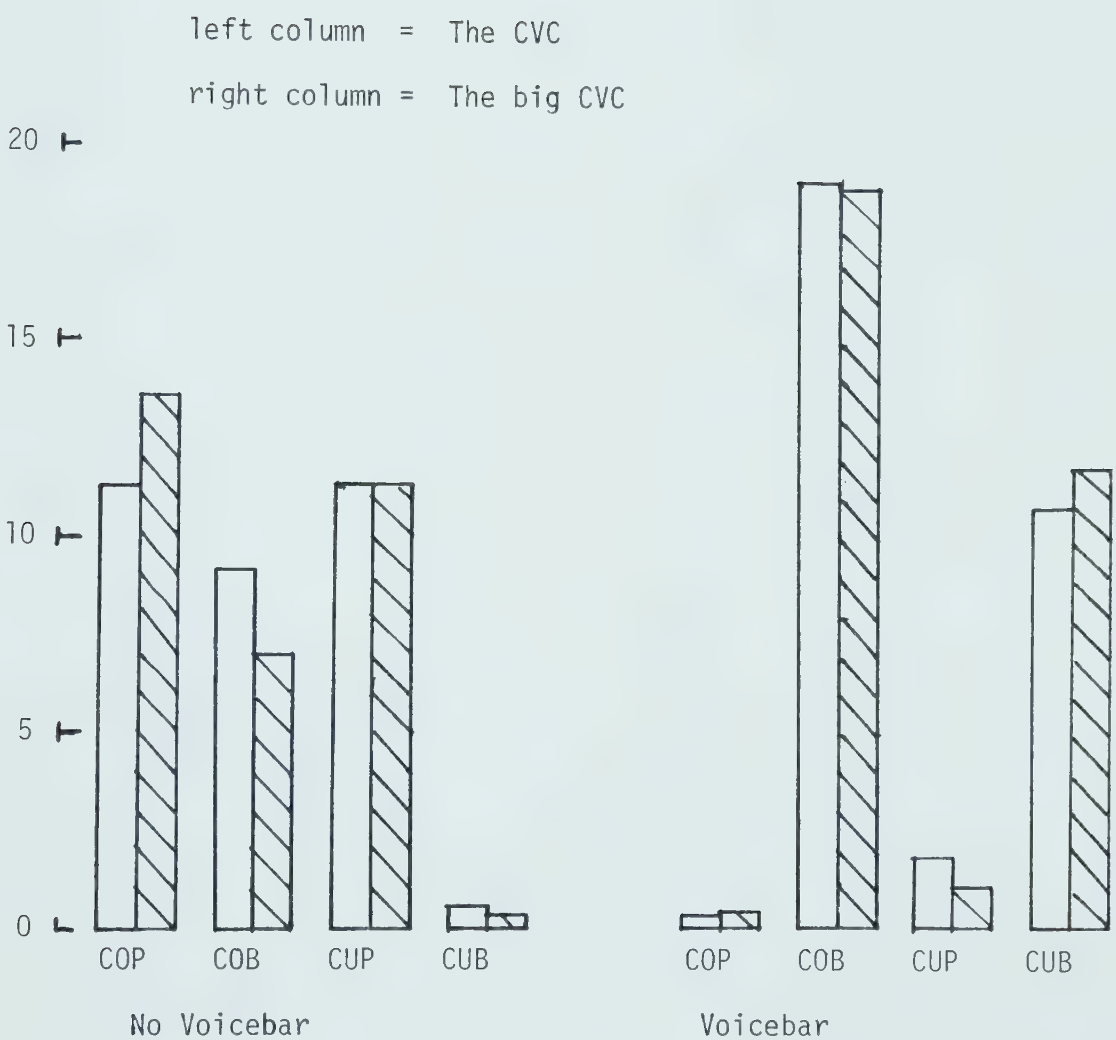


Fig. 4a) Section 1

Frame by voice by response.

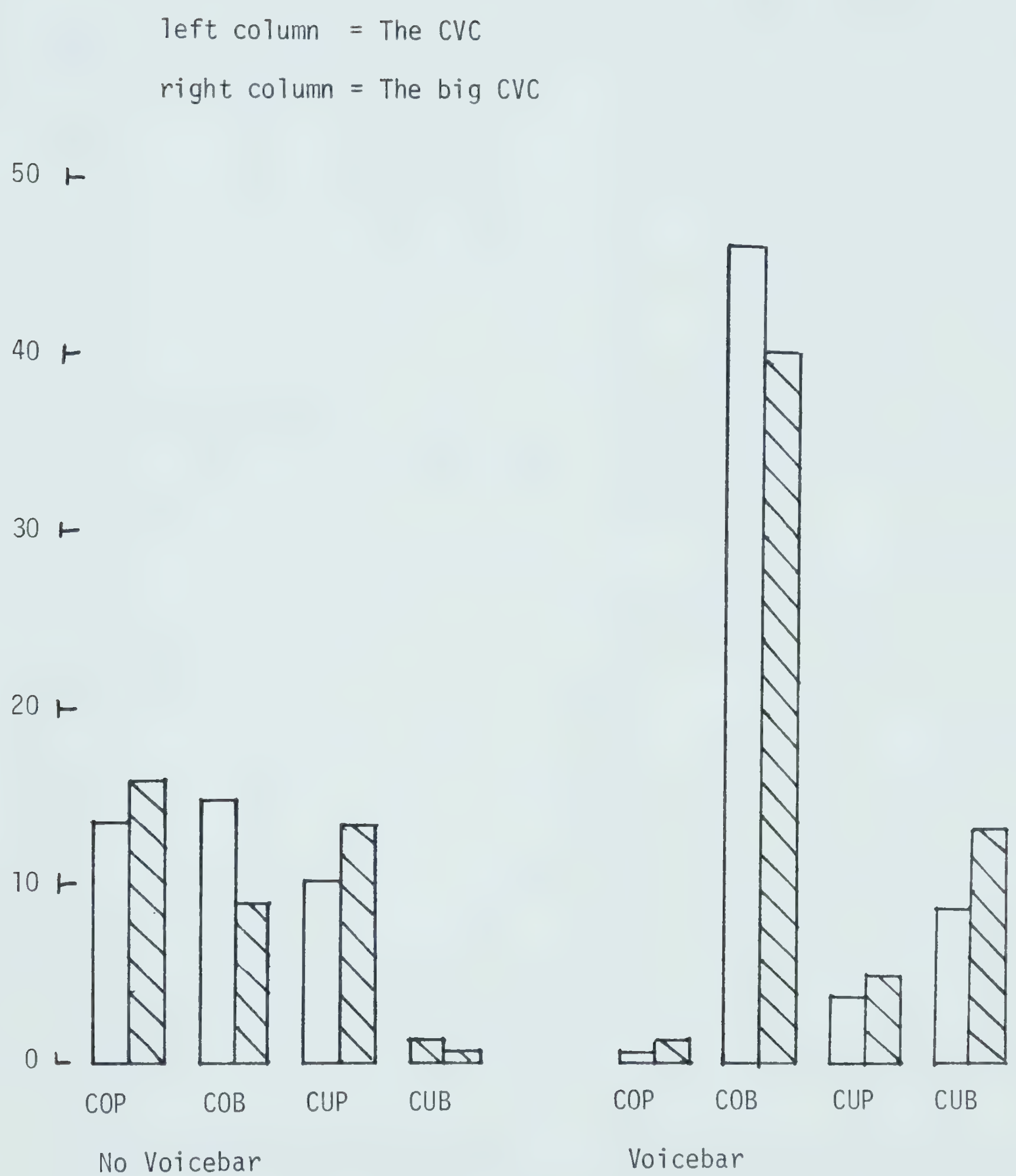


Fig. 4b) Section 2

Frame by voice by response.

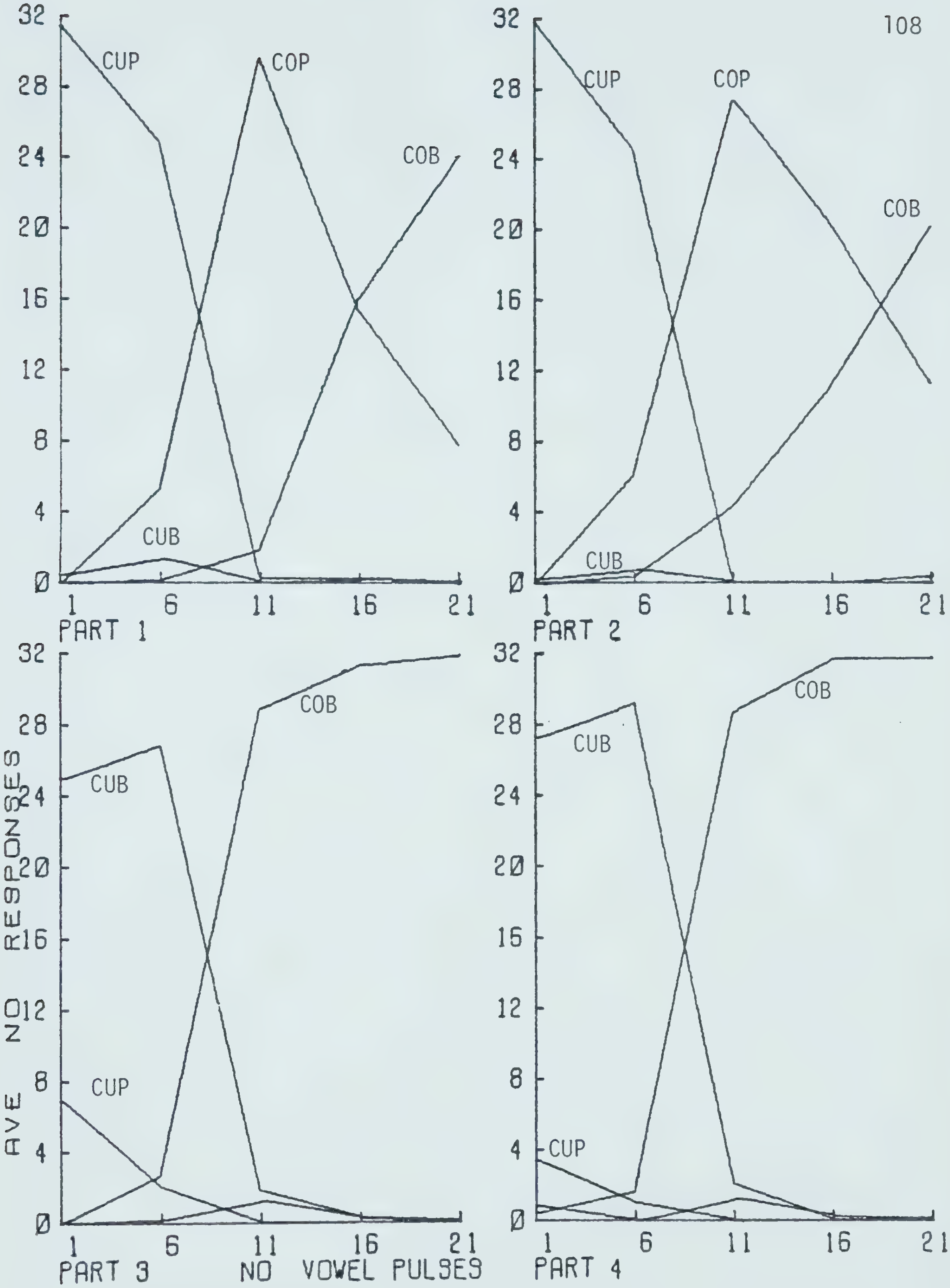


FIG 5A SECTION 1

PART 1	NO VOICEBAR	THE CVC
PART 2	NO VOICEBAR	THE BIG CVC
PART 3	VOICEBAR	THE CVC
PART 4	VOICEBAR	THE BIG CVC

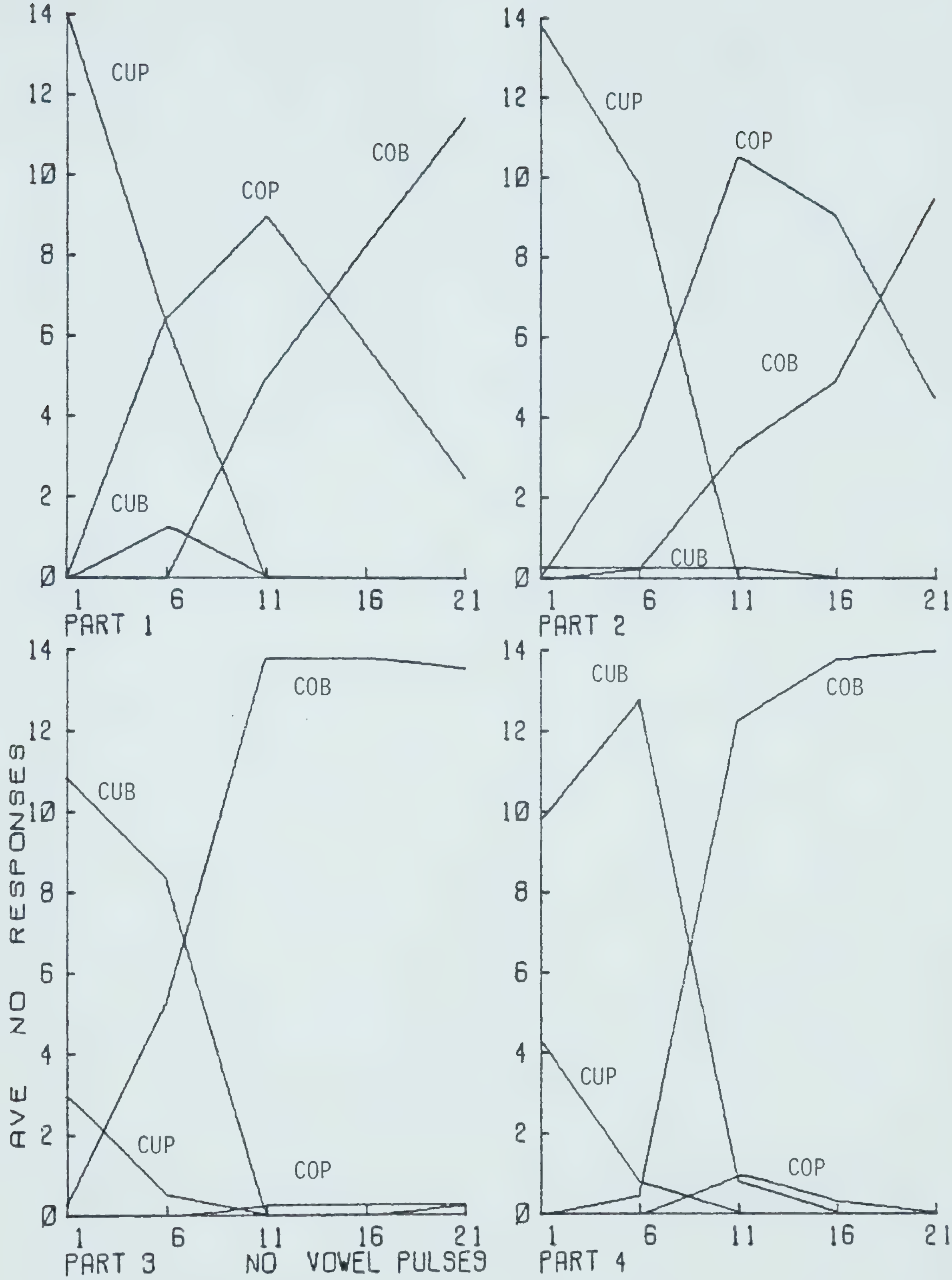


FIG 5B SECTION 2

PART 1	NO VOICEBAR	THE CVC
PART 2	NO VOICEBAR	THE BIG CVC
PART 3	VOICEBAR	THE CVC
PART 4	VOICEBAR	THE BIG CVC

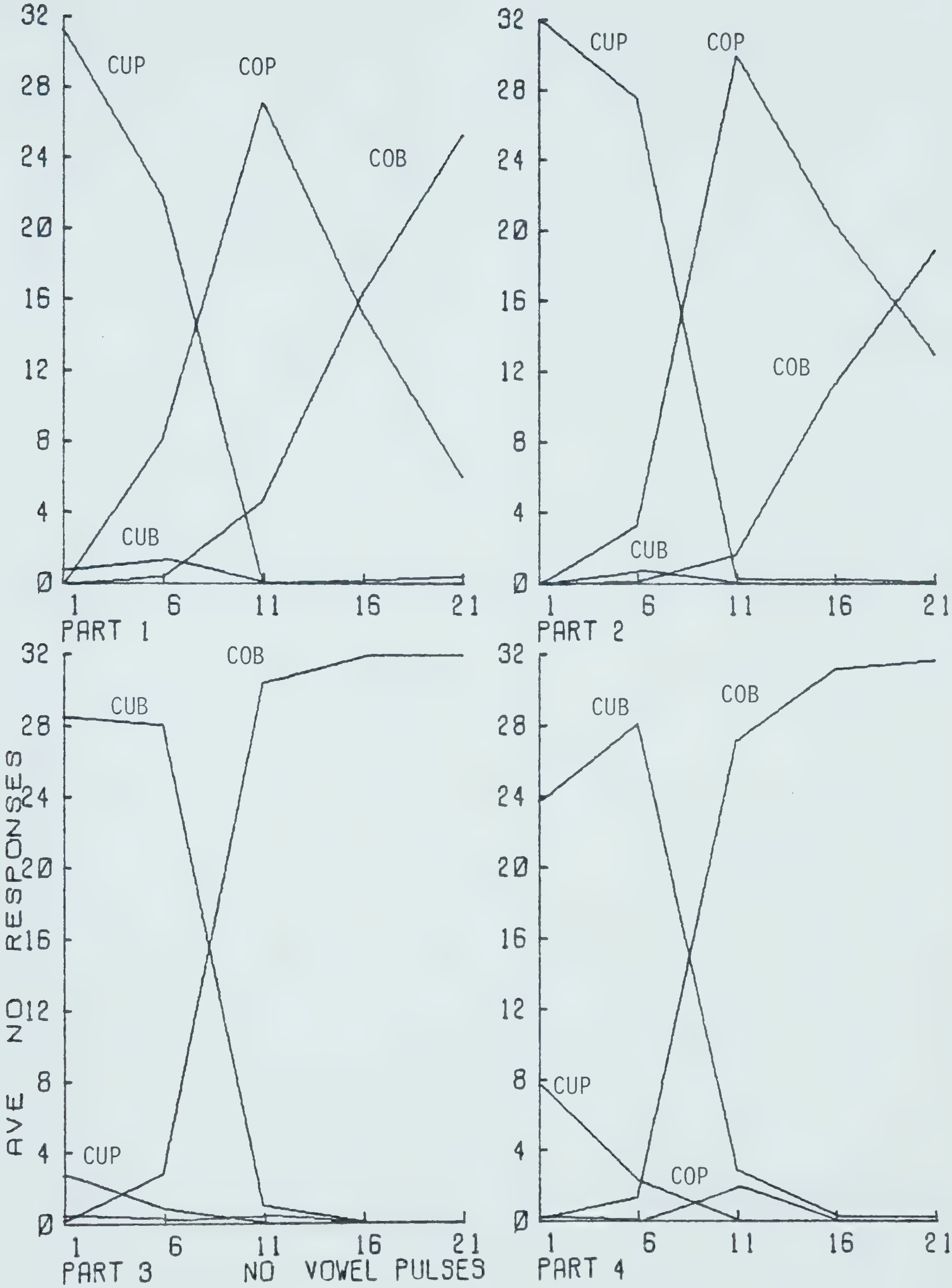


FIG 6A SECTION 1

PART 1	NO VOICEBAR	SHORT PAUSE
PART 2	NO VOICEBAR	LONG PAUSE
PART 3	VOICEBAR	SHORT PAUSE
PART 4	VOICEBAR	LONG PAUSE

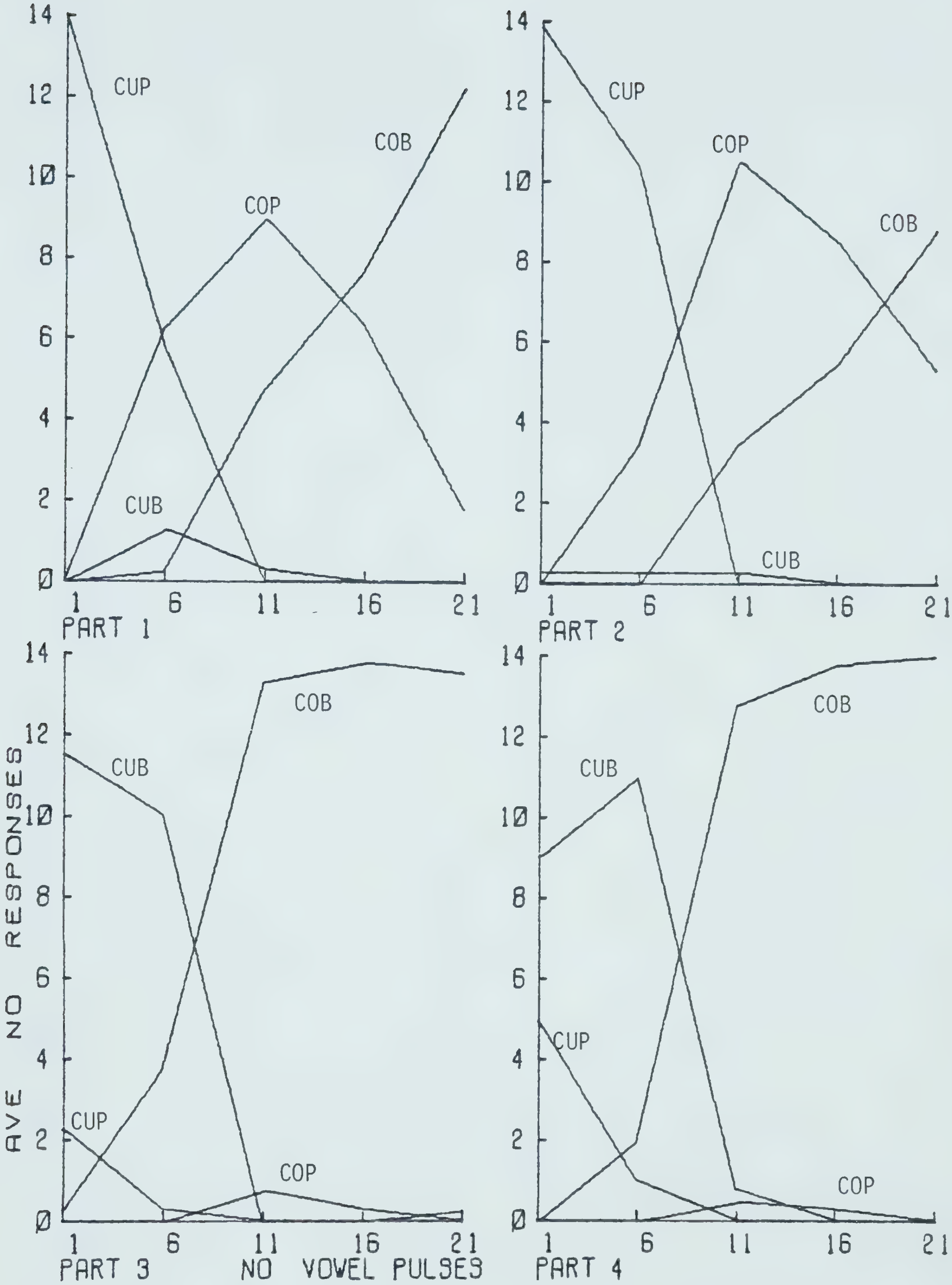


FIG 6B SECTION 2

PART 1	NO VOICEBAR	SHORT PAUSE
PART 2	NO VOICEBAR	LONG PAUSE
PART 3	VOICEBAR	SHORT PAUSE
PART 4	VOICEBAR	LONG PAUSE

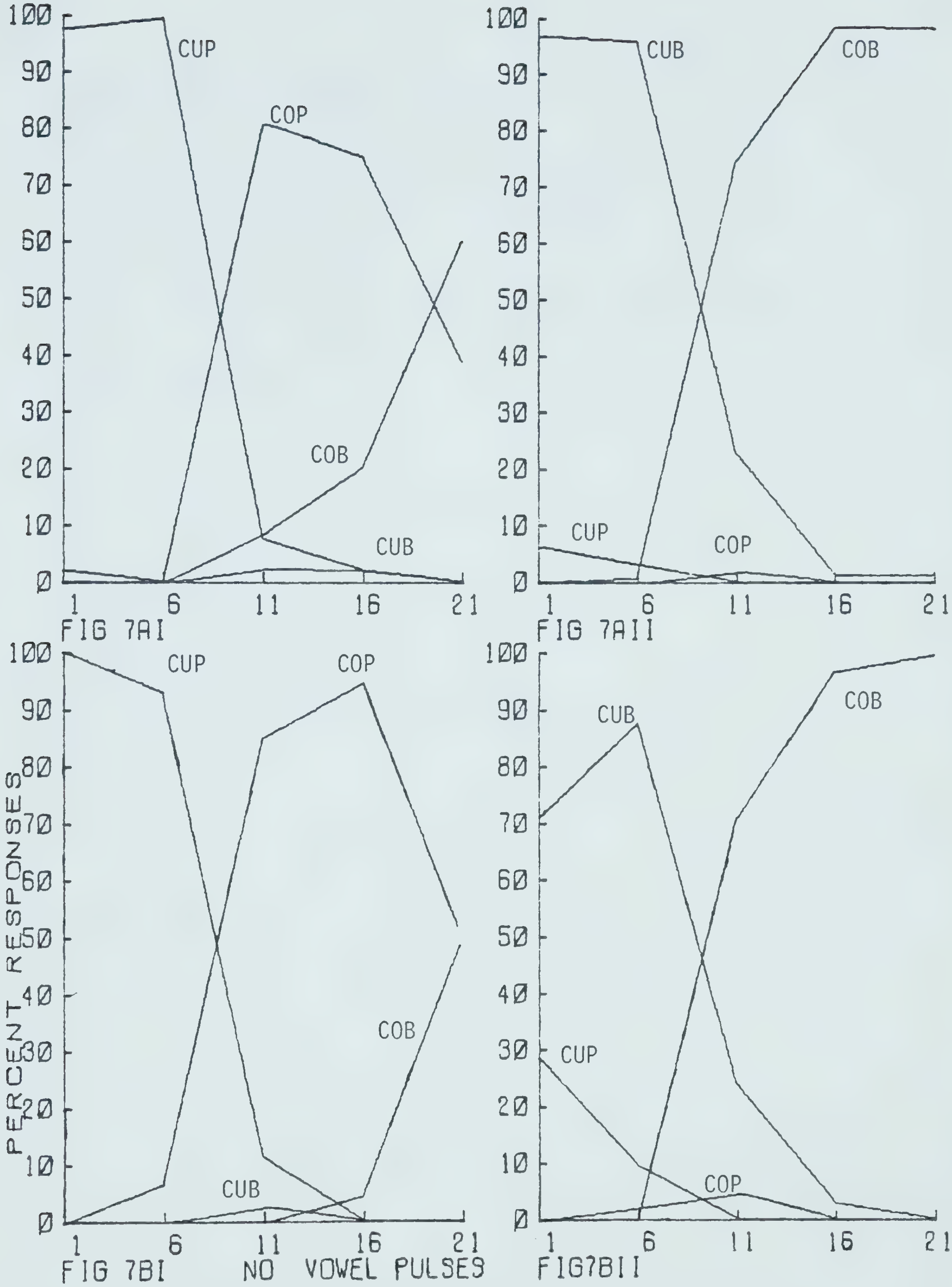


FIG 7

FIG 7AI	NO VOICEBAR	SECTION 1
FIG 7AII	VOICEBAR	SECTION 1
FIG 7BI	NO VOICEBAR	SECTION 2
FIG 7BII	VOICEBAR	SECTION 2

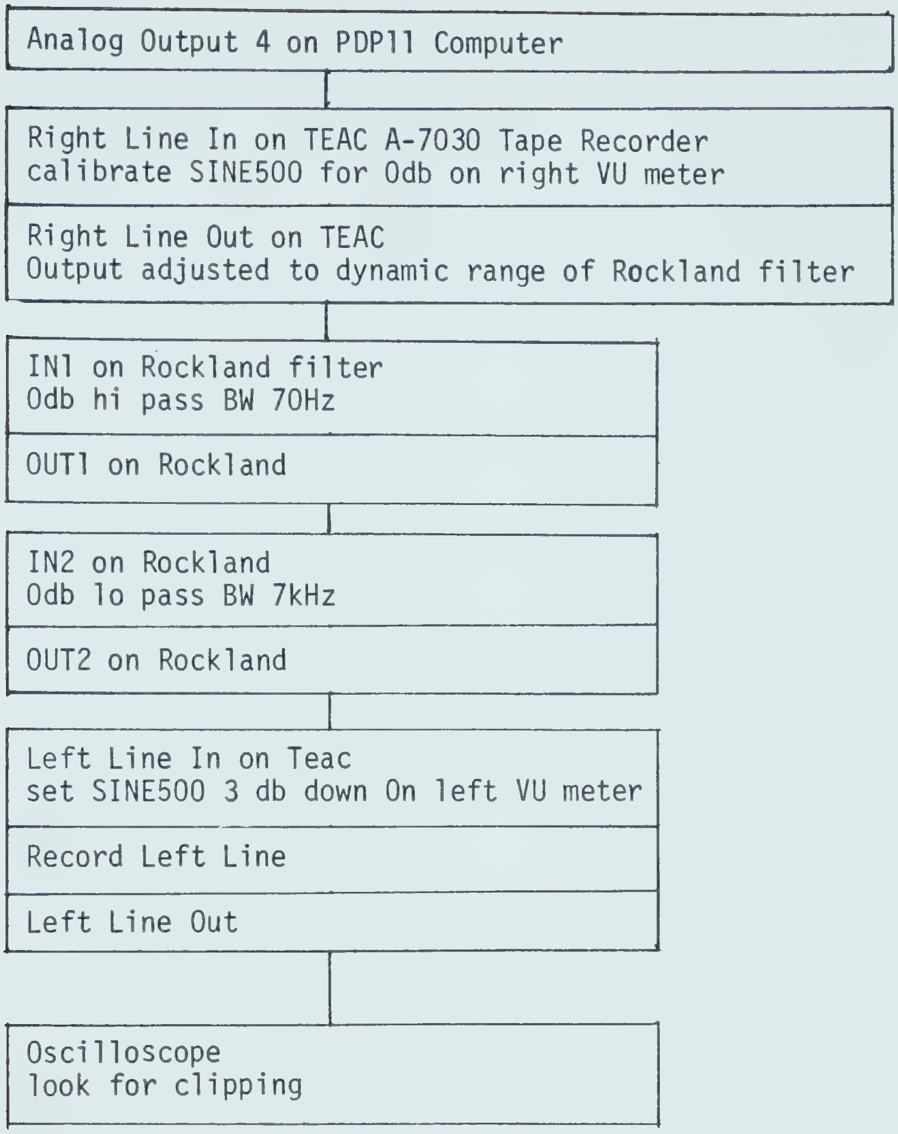


Fig. 8 Recording Setup